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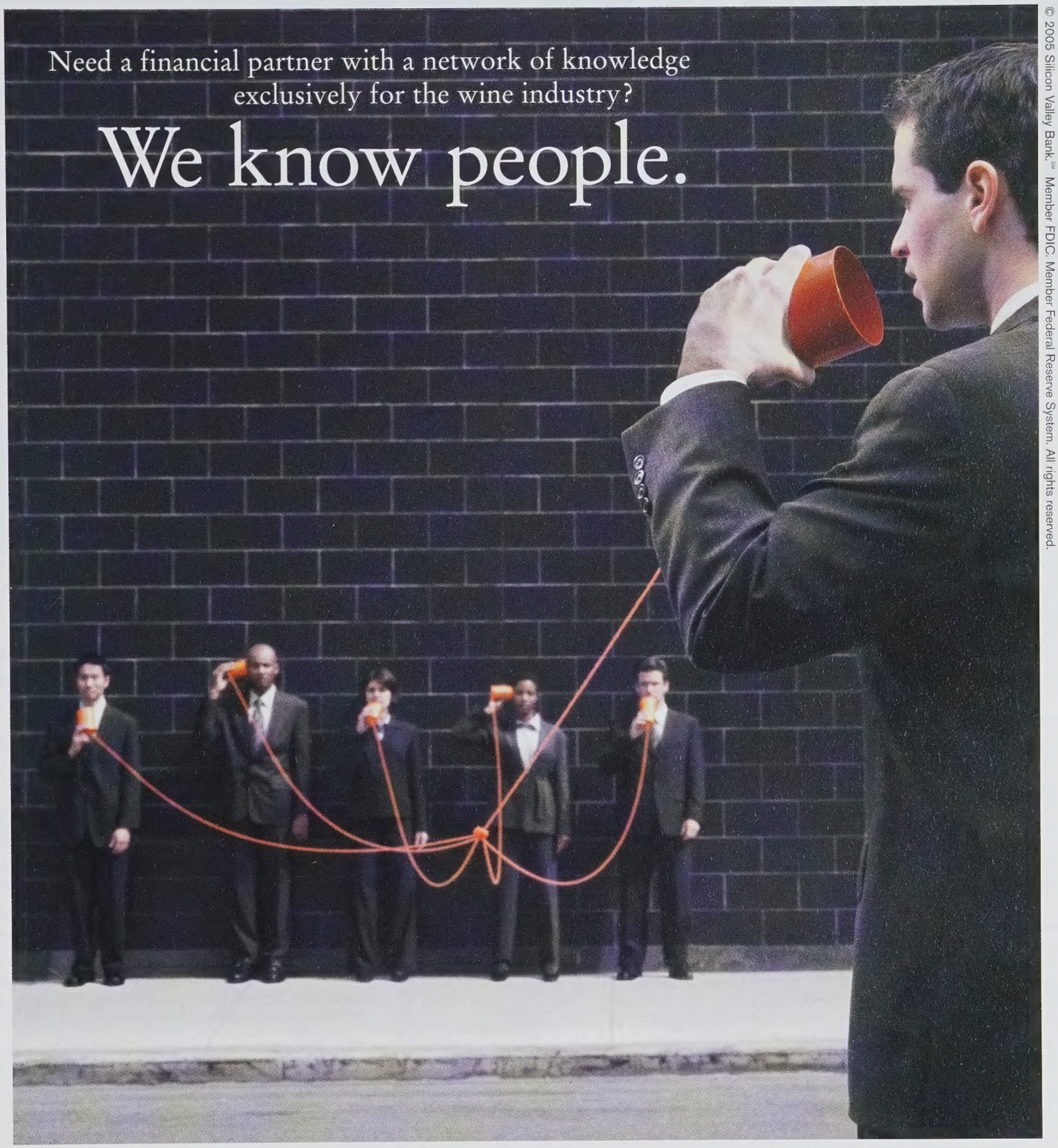

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COVER PHOTO: Mechanized leaf removal at Robert Mondavi Vineyards, King City, CA. Photo by Fred Lyon.

"To stimulate continuing improvement in the wine industry."

Generic Marketing: Winners and Losers

BY Steve Burns

In the United States today, there are no fewer than five state- or appellation-wide wine trade associations with annual marketing and promotions budgets in excess of one million dollars. Another group of similar organizations spends more than three quarters of a million dollars per year on the marketing and promotion of their AVA or one particular varietal.

All of these groups and the activities they support are focused on one thing — making sure that their wine industry niche receives a disproportionate share of media and trade attention.

When you look at regional and country-wide marketing efforts outside of the U.S., virtually all of the major players have promotional budgets that exceed the million-dollar mark. More often than not, much of that budget is earmarked for promoting their wines within the U.S.

While it's impossible to assign complete responsibility for the success or failure of any given appellation, varietal, or national wine industry to generic promotion and marketing, they clearly play a significant role in any successful sales effort.

Almost without exception, every U.S. vintner and grower has the opportunity to belong to a local wine trade organization. In Washington State alone, there are 12 regional vintner and grower associations from which to choose. California has literally hundreds of similar organizations.

Organizations designed solely to promote a single varietal, a single blend of varietals, or even a single roadway within a specific appellation or sub-appellation enjoy impressive success.

Do you participate fully in the promotional programs available to you? In the competitive world of wine sales and marketing today, it makes consummate sense to exploit all of your resources. I encourage all industry members to support your local, statewide, and national associations and to make sure that they are in the "million dollar" club. If they are not, how can you help them get there in the future?

Vintners and winegrape growers in today's cost-cutting environment might be tempted to look at their various trade association memberships and eliminate some of them. Don't. Your gain would be small and short-term, while the loss to our industry would be multiplied and felt for years to come.

Too often, vintners and winegrape growers pay significant amounts to organizations that they do not use. It's the equivalent of paying an employee but giving him no work to do. Every association would surely attest to the fact that more than half of its members aren't involved in association activities and are not taking advantage of things they are already supporting financially.

Exploit your memberships — participate fully in the promotions and programs they make available. Your winery or vineyard and the industry will benefit.

Learn from others' success

The Napa Valley Vintners is a trade association with an ongoing record of huge successes. Clearly, everyone would expect the association of California's Napa Valley to be successful, given the region's global reputation for making great wines, but perceived wine quality alone does not automatically guarantee sales success.

I would argue that Napa Valley's reputation for wine quality is augmented greatly by, the Napa Valley Vintners (NVV), which I consider the hardest working, most proactive wine trade association in the wine world today.

For example, NVV has a consistent, but not overwhelming, system of communicating with its membership, which concisely outlines future promotional opportunities and associate programs. The organization also seamlessly provides membership support in virtually all areas of promotions and marketing, in addition to aggressively protecting the Napa name both domestically and around the world.

To further prove the point that image and awareness are not enough to guarantee success, you only need look to France, which many would agree, is the country with the greatest consumer awareness and is still viewed as the "benchmark" for wine quality by most consumers.

Even with all of that consumer awareness, sales of French wines are falling almost everywhere in the world simply because the French wine industry has spent lots of time worrying about its loss of market share without actually taking action to correct these losses. Clearly image and awareness alone are not enough!

Undoubtedly, the Australian Wine Board (AWB) is also one of the most successful generic promotional programs in the world today, in part because the AWB has a couple of things working for it that American vintners lack. The Australian wine industry suffers from a shortage of wine consumers at home, which forces vintners into greater global outreach, and government entities at the national and regional level recognize the wine industry's value to the country and support it.

Among organizations outside California, Washington state is clearly winning the "battle of the trade associations" by unifying the industry, by taking a long-term approach to marketing and public relations, and by the willingness of member winemakers and winery principals to travel extensively, promoting Washington wines and working hard for each and every sale.

Where did this all begin?

Until the late 1970s and early 1980s, the only vintners marketing and promoting their wines on a global scale generically were the French and the Italians. The New World really wasn't involved in shipping its wines and/or its promotional programs around the world, because it was too busy learning how to make better wines and grow better grapes and trying to sell more wine in its hometown markets.

That all changed when California, Australia, and the rest of the New World began to market their wines in the United Kingdom some 25 years ago. In fact, most wine trade associations were "trained" to promote and market their regions generically in the United Kingdom, which is arguably the most competitive and diverse wine market in the world today.

While the U.S. is widely viewed as the largest consumer wine market in the world, the United Kingdom, and more specifically the city of London, spoils its wine drinkers with an abundance of choice. Where else would you find Sauvignon Blanc from Baja California sitting side-by-side with Cabernet Sauvignon from Lebanon?

At one time in the late 1980s, Australia and California enjoyed the same wine market share in the United Kingdom — about 2%. But that has changed dramatically. Australia now has a whopping 40% of the UK wine trade! California limps along with only 11%.

What generic marketing approach works best?

For vintners and growers searching for the elusive and instant "silver bullet" to generic marketing success, I would argue that it isn't instant magic, it's consistent, focused hard work. Without exception, successful wine marketing associations around the world, such as the NVV, the AWB, and Washington state, have one thing in common: They are unified and focused on doing tastings with potential consumers and getting the word out about their wine. Too many associations spend too much time on logos and slogans and too little time on promoting their wine.

Why isn't every trade association as successful as the best? In my experience, trade associations fail for a variety of reasons. Some seem to lack an overall plan or vision. Some are grossly under-funded or understaffed, overwhelmed with day-to-day activities or preoccupied with putting on complicated annual events or putting out proverbial fires. Such associations don't have the time to do the actual long-term visionary marketing and public relations so necessary to successfully promote your appellation.

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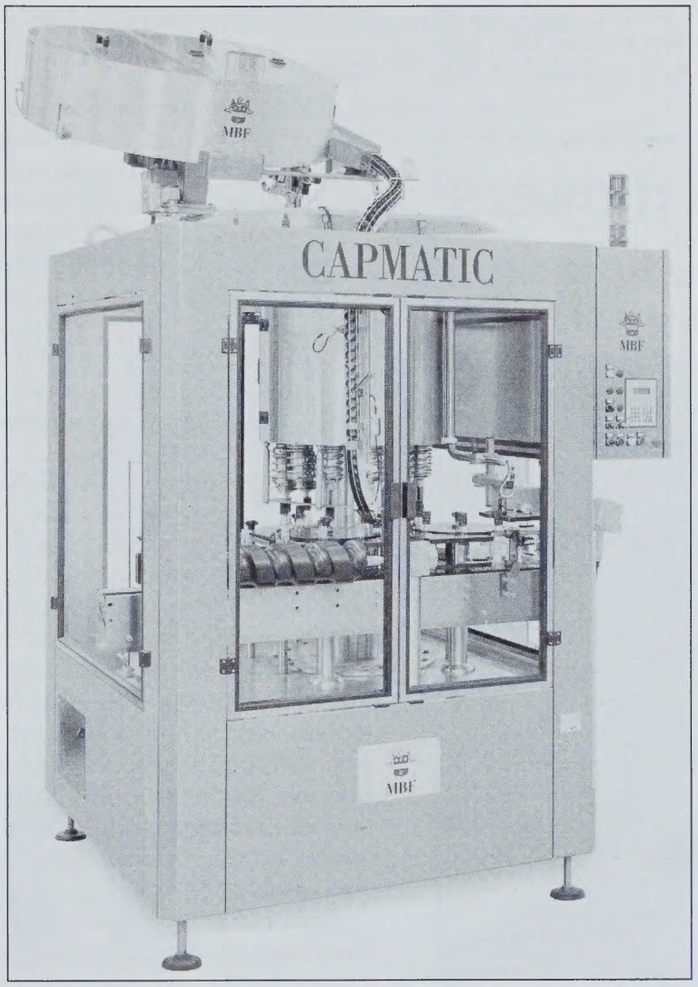

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Is your association conducting tastings around the world as well as here at home? Is it regularly hosting media tours of your appellation? Is it reaching out to the wine trade? Is it constantly polling the membership for advice and guidance? If not, why not?

Seventeen years ago, the leader of the Australian wine promotional effort in London told me that his organization would organize tastings "wherever two wine drinkers gather." Years ago, the French simply tried to get everyone to visit France, and then they brought French food and wine events to the hometowns of everyone who couldn't get to France. These approaches are remarkably similar: You bring potential consumers and the media to your wine country, or you bring the wine or wine country to them!

Get involved!

If your local or statewide trade association is part of the million-dollar club, great! But if you are not personally involved, their successes are not as extensive as they could be with your help, and they may not "spill over" onto your brand. Make sure that your association staff is fully supported and that the association board creates a long-term vision for the marketing and public relations of your appellation or state.

Of course, we all have many excuses for not being involved. Small wineries and growers often think that their association is controlled by the larger wineries; the large wineries sometimes think that they don't "need" regional promotions; the popular-priced producers sometimes argue that their customers only buy on price point; and the premium producers often assume that they are "immune" to any market challenges. Everyone complains about not having enough time to attend association meetings.

Such excuses ignore the larger, common interests shared by everyone who grows grapes and makes wine. When the industry does well, all its members have the opportunity to do well. Your association is working for you — at least sit down with your association staff and board once a year and let them know what you need and how they can help.

Generic promotion and marketing are really a shortcut to sales success, and even more important, they are an extension of your current winery or vineyard marketing staff. That's especially important if the only staff at the winery is you!

In 2005, why not reach out to the trade associations in your region to see what they are offering? It couldn't hurt — and chances are you are already paying for it. Why not begin to get your money's worth? ■

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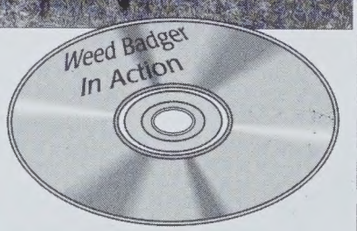

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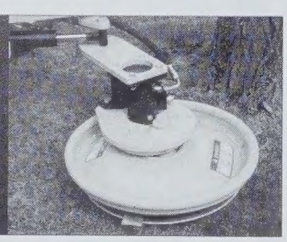
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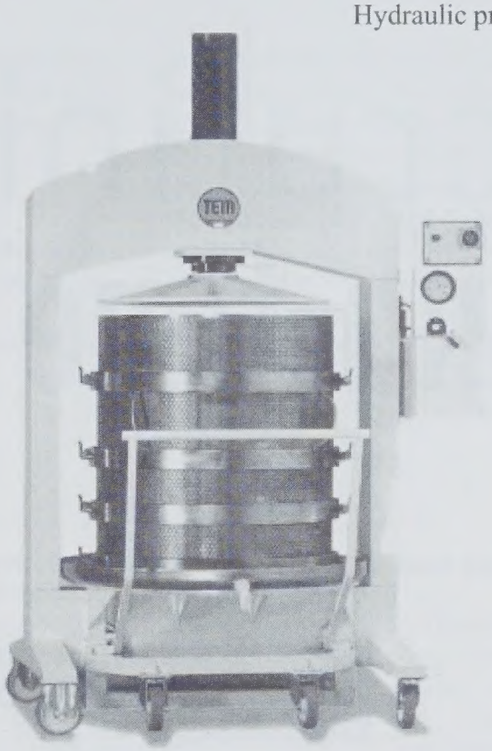

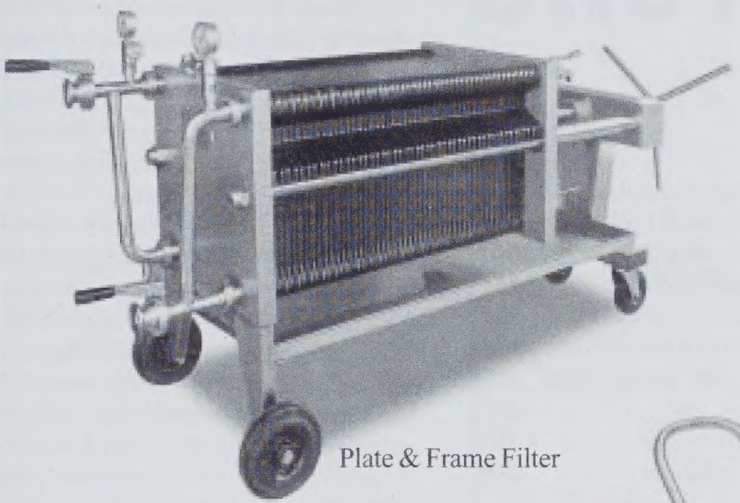

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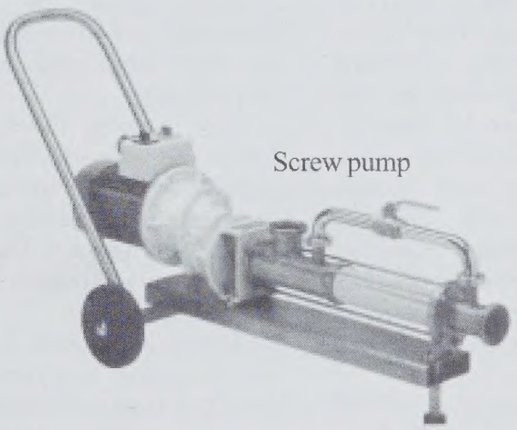

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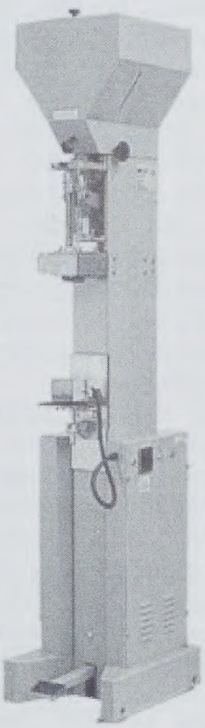

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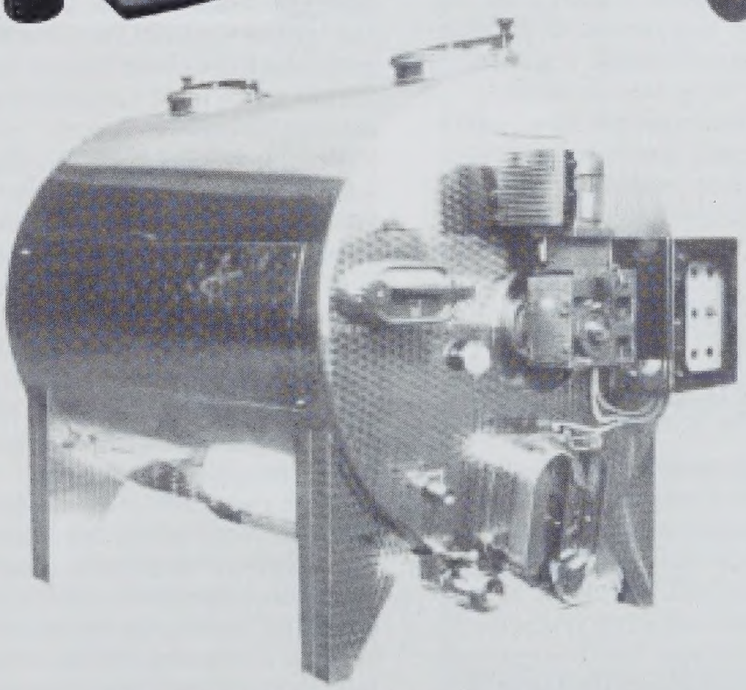

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SMART VITICULTURE

Scrutinizing hang-time trend

BY Dr. Richard Smart

Normally I enjoy public speaking and debating grape and wine issues, but I found the prospect of a "Hang Time" seminar in Napa Valley on January 10 daunting. Nobody expected enormous interest in the topic, yet the Native Sons of America Hall in St. Helena was filled with more than 500 people. Many were turned away, and the Napa Valley Grapegrowers were overwhelmed with the response. Before the seminar, there was a lot of press, some journalists touting the meeting as a grapegrowers versus winemakers clash.

The California Association of Winegrape Growers (CAWG) has expressed two areas of concern about the trendy practice of delaying harvest to allow for allegedly better flavor development. First is the loss of income to growers as a result of dehydration. Second is a purported long-term effect on vine health. The St. Helena seminar was the beginning of a program to raise awareness of the issue. CAWG has commissioned a literature search on the subject and is contemplating research to follow.

Speaker program

Napa Valley grapegrower Andy Beckstoffer was the moderator for the five-person panel, which consisted of Dr. Nick Dokoozlian (E&J Gallo), Bob Steinhauer (Beringer Blass), professors Linda Bisson and Andrew Walker of UC Davis, and myself. In correspondence prior to the event, Nick Dokoozlian and I jested about "going to the gallows, rather than the podium."

Attendees were presented with copies of my two prior columns on the subject: "Hang the hang time" and "Psychological not physiological ripening," which appeared in ***PWV***, Jan/Feb 2003 and Sept/Oct 2004, respectively.

Also among the handouts were Linda Bisson's excellent ***PWV*** article (July/Aug 2001), "In search of optimal grape maturity," and a recent interesting paper from UC Davis about crop yield and wine quality (*Am. J. Enol. & Vitic.* 55: 325–334).

In my comments, I noted that, in nature, grapes may remain on the vine past the time of normal commercial maturity, so hang time is unlikely to have a negative impact on vine health. But I questioned just how effectively grape tasting can predict harvest date, and why enologists might want to rely on this. This practice is an important reason why the alcohol content of some wines is rising. I questioned how consumers might respond to this trend and whether it is in the best interests of the increasing American wine exports, for instance.

I also suggested that the practice of delayed harvest might be a reflection of growing varieties in an inappropriate, hotter-than-optimal climate, and that this issue will be further exacerbated as global warming proceeds. In my opinion, harvest time has minimal impact on wine quality; there are other vineyard practices that can have much, much more impact. One such example is the regulation of shoot growth, which, pre-veraison, can have a major impact on "veggie" flavors in grapes.

Individual summaries

A brief summary of each speaker's presentation follows:

Nick Dokoozlian was able to relate some of his recent research at E&J Gallo. He made the important point that we need to consider the effect of maturation time on flavors, which impacts both positively and negatively on quality. Of the latter, methoxypyrazines, which cause veggie or herbaceous characters, are very important.

Nick showed results of a study in which trained panelists assessed berry flavor as fruit or veggie during the maturation period. Veggie flavors declined before fruit flavors were maximal, but, in some cases, fruit flavors declined at excessively high brix. Many winemakers feel it is critical to delay harvest of red wine varieties until no vegetative flavors are present. The rate of this degradation is highly dependent upon temperature and other environmental variables.

In some cases, Nick showed that yield losses may occur at high brix, with the extent depending greatly upon overall vine condition and stress during ripening, the growing region, and grape variety. His studies also indicated little likely impact on vine health or future yield because of delayed harvest.

Bob Steinhauer and his Beringer winemaking colleagues have been making pre-harvest vineyard inspections for many years; he believes this is a necessary part of ultra-premium quality winemaking. He stated that the practice involves more than tasting fruit. Vineyard condition and fruit composition are also assessed, and consideration is given to winery capacity and impending weather.

Some varieties, like Zinfandel, appear to need some dehydration for the sake of wine quality. He also emphasized that delaying harvest can carry its own risks, such as the arrival of a very hot spell. Bob ended his talk with a plea for research that will lead to grapes with full fruit flavors but lower alcohol.

Andrew Walker gave a thorough review of how hang time *may* reduce vine health and future yields, but he concluded that there was little evidence to support it. He indicated there is a possibility that hang time may affect carbohydrate movement in the vine, but that his observations of root flushes, for example, show a dominating effect of water availability.

Andrew also stated that there is a potential for hang time to impact late cluster development and therefore bud fruitfulness on canes. The buds at the base of a cane will develop clusters earlier than those formed four to six weeks later at the end of a cane. Where vines are under stress, as on shallow soils, for example, there could be more opportunity for negative impacts.

Linda Bisson stated that the traditional measures of sugar and acidity are useful, as they are independent of variety and related to berry physiological stages. The chemistry of ripening berries is complex and not always well understood. There are other possible chemical indicators of ripeness, such as arginine/proline, phenols, glycoside-glucose, and protein content, but none appear definitive. Physical features, such as seed integrity, berry deformability, skin detachment, and chewiness, are useful, but often not predictive.

Linda questioned the tasting of fruit, wondering what can be tasted, and how sensitive and reliable tasters can be. She cited a need for protocols to assure reliability. Linda also said that trials on harvest date have shown that middle maturity is generally better than very early or very late, but there is a lack of clear preferences.

High-sugar grapes have high pH and also a high microbe load, which need to be handled in the winery with more sulfur dioxide. She concluded that there is likely no one ideal measure of optimal flavor and that values of many components can change independently.

She suggested that, as a result of undercropping, many vineyards today may attain high sugar before the grapes are ripe for other important characteristics. She explained that undercropping accelerates sugar accumulation and uncouples optimal flavor ripeness from optimal sugar ripeness. Thus, sugar levels are too high by the time optimal flavors are obtained.

Conclusion

Though winery people comprised the majority of the audience, there was little audience input to support the hang time trend, which surprised the panelists. There was agreement among the panelists that more research is needed, and I expressed amazement that support for hang time is apparently so deeply ingrained among winemakers, despite little supporting evi-

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dence. Some speakers questioned the role of wine critics in this trend to hang time.

High-alcohol wines are not restricted to California. The problem is also rampant in Australia and is even affecting some Old World wine styles. I suspect that more attention will be given to this issue in the future, which will, I hope, include more research. I also suspect that the trend will start to become less fashionable, as enologists begin to realize that there is more to vineyard management practices to improve quality than just tasting grapes.

The term "dead fruit" wines has been coined in Australia to describe these high alcohol wines. May the process of hang time, which produces them, soon die a natural death. ■

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WINE MARKETING

Marketing insight for a small winery

BY Carol Caldwell-Ewart

When Jim Law (with his family's help) bought a 76-acre hard-scrabble farm in the Blue Ridge Mountains of Virginia and began establishing a vineyard and winery in 1983, he was living a dream. When it came time to market his wines, though, the dream took on nightmare qualities.

"I'm a winegrower. I spend most of the growing season with the vines and a good deal of the fall and winter in the cellar. I love it. This is what attracted me to the business 25 years ago," Law recalls. "Once I started my own operation, it became apparent that I would have to spend a significant amount of my time selling wine." But selling wine took him away from what he loves best. "My goal then remains my goal today — to spend as little time as possible on the marketing end of the business."

Law's story is a familiar one to many start-up wineries, and his marketing evolution at Linden offers an example that may provide helpful ideas if your small winery has similar marketing challenges.

Profile of Linden Vineyards

Linden is a 5,000 case winery 65 miles west of Washington, DC, in a developing wine region. Law planted his first six acres in 1985 and released his first vintage (1987) and opened the winery in 1988. The estate vineyard now encompasses 18 acres. It and two nearby vineyards owned by Linden employees supply all the grapes for the winery.

Vineyards are Law's focus. "Soil, site, and microclimate are more important than grape variety," he says. Vineyard practices are inspired by the French. "For many years, I traveled to California to learn techniques and philosophies in the vineyard. Eventually it became apparent that I needed to look east rather than west. In the non-Mediterranean viticultural areas of France, they have growing conditions similar to what we have in the mountains of Virginia: diverse soils, erratic weather, and viticulture on a small scale. They have learned to micro-manage each site according to its needs and how to change vineyard practices as the growing season unfolds — whether it's hot, wet, cold, or dry."

Varieties planted at Linden include Cabernet Sauvignon, Petit Verdot, Cabernet Franc, and Merlot; Sauvignon Blanc, Vidal, Chardonnay, Seyval, Riesling, and Petit Manseng. Law is currently removing some grapevines to replant with more appropriate varieties and training systems. "Over the years we have learned which soils and sites each variety likes best. We didn't get it all right when we first planted."

For example, the wrong Chardonnay clone had been planted on soils better suited to high quality reds; Cabernet Sauvignon produced disappointing, vegetative wines on heavy clay soils; and Riesling rotted and made mediocre wine in this region. All three are being removed.

Cabernet Sauvignon is being replanted on warmer slopes in thin, well-drained soils, and Law has chosen to add Petit Verdot and Merlot — which can handle heavier soils — and the white variety Petit Manseng, "which seems to be bullet proof in the vineyard and produces a late harvest wine with great intensity and very high acidity."

Vineyard yields are from 2.5 to 3.5 tons per acre (TPA) for reds, 3 to 4 TPA for Chardonnay, and 3.5 to 5 TPA for other whites.

In outstanding years, Linden makes reserve wines, but so far, that's only been in 1997 and 2001. Most years, the winery makes single vineyard designates: "These are blends that best show off the vineyard site and have depth, concentration, and balance," explains Law. Claret and Cabernet Franc are the winery's entry-level wines, and "In a lesser year, they can comprise nearly 100% of the red wine bottled at Linden. In an excellent vintage, they will be less than 50%." Lots that don't fit into the winery's blending program are sold on the bulk market.

"In the French language," Law observes, "there is no word for winemaker. I share their philosophy that the wine makes itself with some minimal human guidance. Over the years, I have found that most of the important decisions are made before fermentation. Most of our focus is in the vineyard and in the initial winemaking stages of evaluating grape maturity, selective hand picking, gentle handling, sorting, and small lot fermentation.

"I am always mindful that a wine's first job is to complement a meal. Because of this, I prefer my wines to have good acidity and structure and moderate alcohol." Law doesn't add acid, but he shoots for whites with 7 to 9% and reds with 5 to 7% TA. Alcohol level in white wines is 11 to 13% (less than 10% in Riesling and Vidal) and in reds is 12.5 to 13.5%.

In the early years, Linden production was 85% white wines, currently it is about half whites. "In five years, it should be 60% red." The wines are unfined and unfiltered. "We are non-interventionists in the cellar. The result is wine with more flavor and texture," he explains. "This can be at the expense of

Jim Law

sediment or haze in the bottle, but that is a risk we feel is worth the benefit."

When making white wines, Law says he strives for "sap" and verve. "Sap refers to the intensity, weight, and structure in a wine that come from the vine. There is a concentration and verve of great intensity, but the wine is in perfect harmony and balance, this is my ultimate goal with our white wines."

His goal with reds is "to produce wines that are firmly structured, harmonious when young, and that become supple and more complex with time." White wines retail from $15 to $23 and red wines from $18 to $29.

Linden Vineyards' wine selling history

Law believes that, ironically, limiting his selling efforts so he can focus on growing grapes and making wine is the basis of the financial success of Linden Vineyards. By minimizing the resources the winery puts into sales, marketing, and promotion, he maximizes the profit margin of every bottle of wine they sell. "Most of our wine is sold in our tasting room," says Law. "I consider any wine sold through our distributor a marketing expense rather than a profitable sale. This is the reality of small wineries and the three-tier system."

Recently, Law reflected on his "personal, nuts and bolts" marketing saga, and we've printed his thoughts below.

PHASE I
Scared to Death (1988 to the early 1990s)

"MY EARLY BUSINESS LIFE CENTERED AROUND CASH FLOW. It's hard to be a visionary when you are constantly worried about how you are going to pay the bills. Linden Vineyards' marketing reflected this. I call it shotgun marketing. Sell bottles to anyone, anywhere, anyhow — festivals, winery events, store tastings, dinners.

"I get exhausted just thinking about it. The vineyard was occasionally neglected — just not enough time. Wine style was dictated by market trends rather than vision or *terroir* expression.

"Marketing consisted of attracting bodies into our tasting room, located several miles down a narrow, winding mountain road. There was a certain comfort level associated with lots of people in the tasting room. We knocked ourselves out giving tours on

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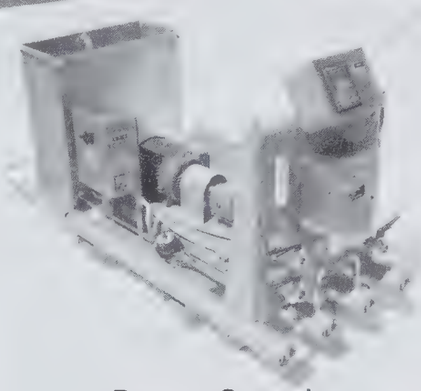

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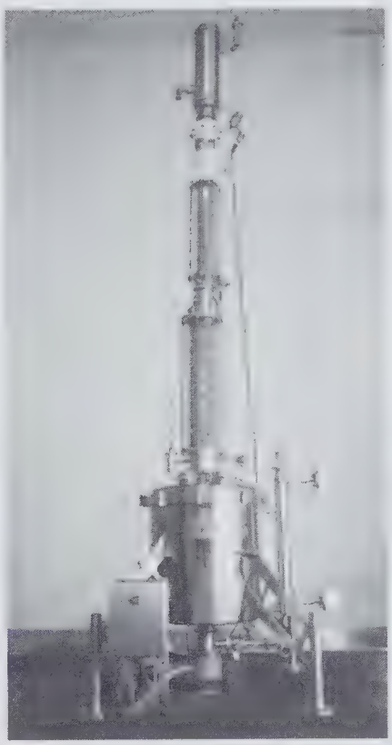

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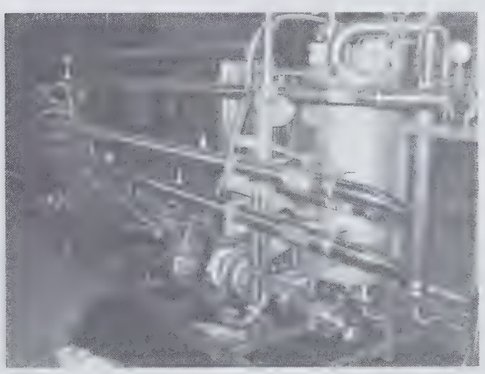

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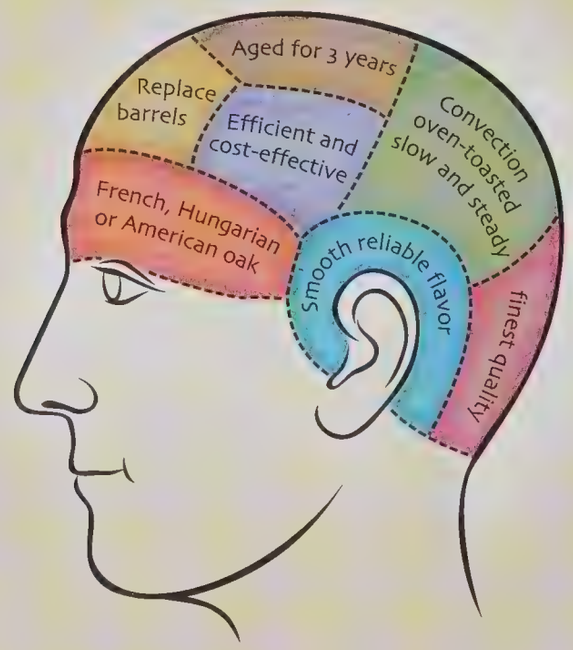
demand and lengthy tastings to sell one bottle of wine.

"The first year in business, we sold out all of our wine. This made me feel good and encouraged me to start an aggressive planting program in addition to leasing some local vineyards. This also led to a massive cash flow problem that took me years to dig out of. I'm still paying back the loans.

"I see this scenario repeated regularly by new wineries: The first year is the 'honeymoon.' You are the new kid on the block, and retailers and wine enthusiasts want to check you out. That tiny first year's production sells out fast.



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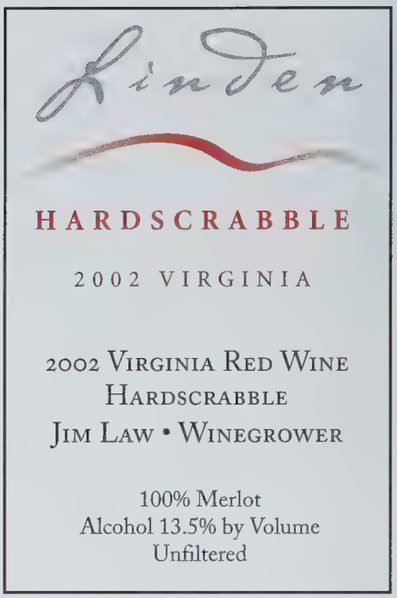

Customers are begging for more wine. You plant more vines and buy more grapes, more tanks, barrels, bottles, corks.

"Then when the new and greatly increased inventory is ready to sell, it no longer seems to fly off the shelf. There is another new kid on the block.

"But for us in fact, the wine was selling just as it had the previous year — we easily sold 800 cases, but we needed to sell 3,000. Selling 3,000 cases is different than selling 800, and when inventory is backing up in the pipeline, it seems like you can't give it away fast enough.

"The monthly payments to the bank continued to make festivals and winery events very attractive. The candle was burning at both ends.

"My epiphany came one Labor Day weekend in the early to mid-1990s. I had just reviewed my accountant's report showing that marketing costs per bottle greatly exceeded production costs. That Sunday we had one of our Jazz Concerts at the vineyard. It rained. The musicians set up in the cellar. The winery was packed with people having a good time. The musicians decided that Jimi Hendrix fit into our agreed upon classical jazz format.

"What had I created? Was this why I got into this business? What business was I in?"

Phase II
Smart growth and the courage to do nothing (early 1990s to late 1990s)

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we were doing. Targeting the 'right' customer became the focus. I decided that the wine had to be the sole profit center. Everything else was eliminated. Linden's profit margins soared.

"It soon became apparent that most of the events had been money losers, especially when staffing costs were correctly allocated. We did continue to do some limited events, but they were focused only on wine education. I was relieved to get out of the gift shop business, which again, once staff time was correctly factored in, turned out to be only marginally profitable.

"We all became less stressed and more relaxed with customers. Wine sales increased. Linden was about wine and was attractive to customers who were interested in wine. People looking for entertainment during a day out in the country went elsewhere. Our marketing efforts shifted from getting people in the door to giving them good, knowledgeable, professional service while they are here.

"I have a great staff that has been with Linden for a long time. I attribute much of this to the low stress environment that has been created by eliminating superfluous events and reducing the group/ party traffic in the tasting room. Selling wine is about relationships. Customers don't form relationships with burnt out, overwhelmed people behind the tasting counter."

PHASE III
Jamais content *[Never content]* *(2000 to present)*

"I STOPPED WORKING FOR THE BUSINESS AND THE BUSINESS STARTED WORKING FOR ME. My desire is to make great wine. This takes an enormous amount of capital and the luxury of creative time. I have had the opportunity to travel to many of the great wine producing regions and have realized that we, in the eastern U.S., have an amazing marketing advantage. We live in our market, know it intimately, and have a loyal, 'patriotic' clientele.

"I am taking the easy money of direct sales and investing it in my vineyards. Viticulturally, we have certain disadvantages in comparison with the rest of the world. These disadvantages can be overcome by smart management and lots of expensive labor, and the wines get better and even easier to sell.

"I have learned to stay in touch with my best customers through occasional notes and letters. I still believe that email doesn't dovetail with the small upscale feel of Linden. We have many great restaurants and bed and breakfast inns in this area that are increasingly catering to 'gourmet tourists.' I am making more of an effort to stay in touch with these operations.

"Linden has dropped out of the wine competition circuit. I've never been comfortable talking about medals or using them to sell wine. My goal is to produce unusual wines with charac-

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"I have also started an extensive commercial library of past vintages. I am finding that our wines are ageing gracefully. We do special reserve tastings and like to feature some of the older wines to prove the point.

"Finally, I am slowly recognizing which wines are becoming our signature wines. The Baskin-Robbins approach (31 flavors offered) is slowly being phased out. This requires removing vineyards, which is emotionally difficult, but I feel now is the time to force change if I am to continue to progress.

"None of these changes could be possible if it weren't for an inquisitive, knowledgeable public. I am constantly amazed at the increasing sophistication of our customers. New customers usually come to Linden with a recommendation from a trusted, respected source. They find that the building and grounds are tasteful, clean, and well cared for, that the staff is intelligent, professional, and low key. They learn that the wines are good, and there is no hype — no special deals or promotions. They have made a discovery. Linden is their winery."

Linden Vineyards today

Linden sells about 12% of its wine through a distributor to 12 selected restaurants, more than 20 retail wine shops, and a handful of gourmet groceries in Virginia and Washington, DC, though the winery staff handles distribution to shops and restaurants nearby.

"I do want to make sure that the top restaurants in our area have our wines," notes Law, "as this region is evolving into a gourmet tourist destination (thanks originally to The Inn at Little Washington). When our wine is recommended and enjoyed at The Inn, customers are often at the winery the next day buying cases.

"My goal is to be in a limited number of small independent wine shops," he adds. "I am trying to get out of any chain or big box stores. This is partly for reasons of 'product positioning' and partly because I have a personal disdain for these operations and want to support small, locally owned businesses. I am no longer putting UPC codes on the back label."

Law reports that mail order sales are insignificant, and the winery ships only to customers in Virginia (though these sales may increase if shipping laws change). "A number of years ago we hired a consultant to take us through the step-by-step process to set up and run a wine club — some of the best money I ever spent," he claims. "It became apparent that the time, resources, and headaches necessary to do a wine club were beyond what we wanted to commit. I would rather just bottle less wine."

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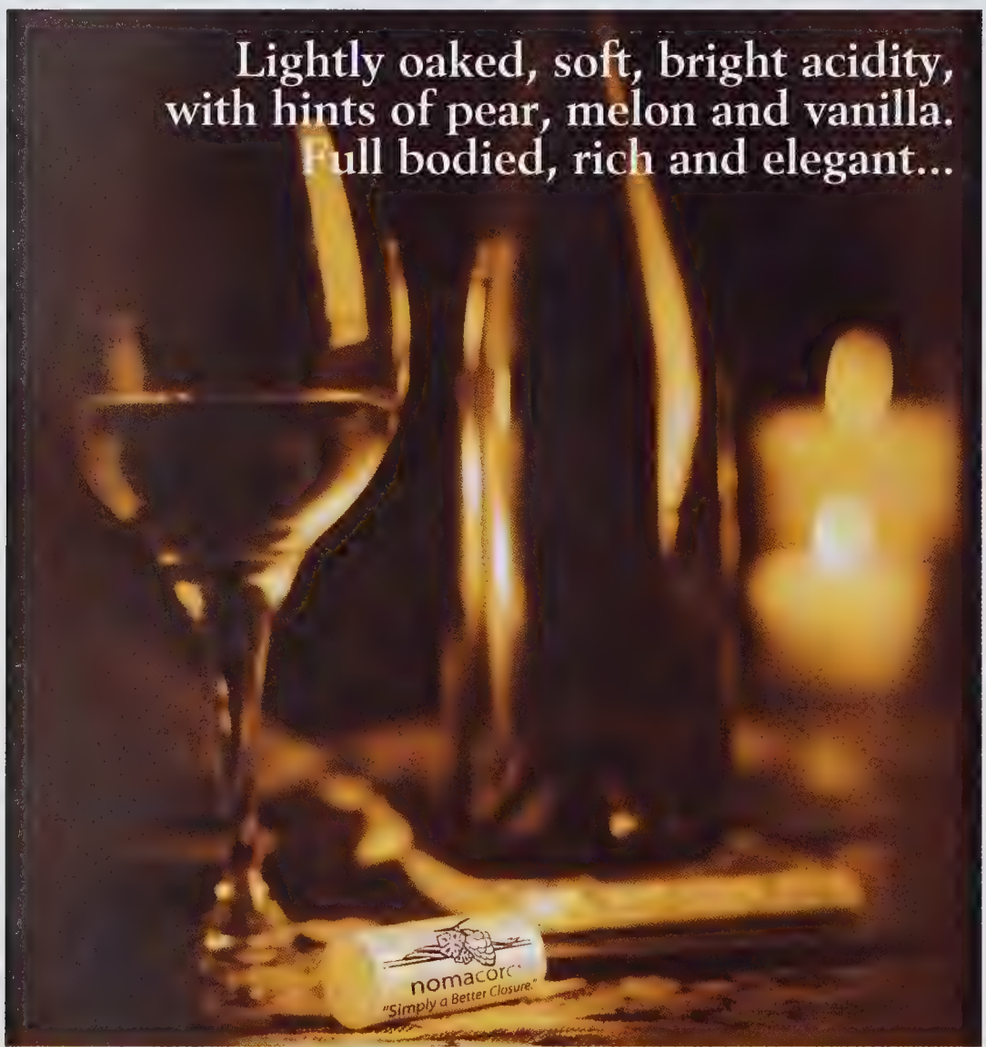
The remaining 85% of Linden's wine sales are through the tasting room door. Tasting is generally free, but the winery charges $10 for the special reserve tastings, which are held every half hour on weekends.

Despite the winery's reliance on cellar door sales, Linden Vineyards is also Law's home, so everything closes up at 5:00 PM. The winery hosts no weddings, no groups more than six, and no tour buses.

Law says he reserves the quiet winter months as a time of review and reflection, a time to consider the direction of the winery and what needs to change. "Like most small business people, we spend an enormous amount of time working. It defines who we are. If we love our work, chances are quite good that the business will succeed. This is why I feel that it is important to tailor the business around the personality of the people running it. People change, and often the business needs to do the same."

By taking control of his business — particularly the marketing and sales — Law has created a business that reflects his values while achieving sales goals. "I have the good fortune to be the steward of this land. I farm it with great care and respect and take great pride in sharing it with visitors. Just as I try to achieve balance and harmony in my vines and wines, I also try to achieve the same with my life, my farm, my neighbors, and my community." ■

This text was edited and expanded from "History of selling wine at Linden Vineyards" by Jim Law, published in Wine East, *September/October 2004.*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Abscission (yellowing and dropping) of basal leaves is an indication of excessive water stress and should generally be avoided.

MONITORING AND SCHEDULING

Integrated irrigation of California winegrapes

BY Mark Greenspan, Ph.D.,
Viticulture research manager
Gallo of Sonoma, Healdsburg, CA

Does dry farming produce superior wine? Not always. We are fortunate in California to enjoy conditions that are undoubtedly among the best in the world for growing wine grapes. Water resources are abundant to maintain vineyards throughout the season, even with a nearly complete lack of summer rainfall.

Despite living in a climate of seasonal aridity, we all too often attempt to mimic the Old World style of grape growing without supplemental irrigation.

However, it is critical to remember that California's rainfall pattern differs tremendously from Europe's. For instance, Bordeaux receives almost 33 inches of annual rainfall, distributed almost uniformly throughout the year (Figure I). In contrast, St. Helena in Napa Valley totals almost 35 inches — most all of it falling over a six- to seven-month period.[7,8]

St. Helena, like much of California, receives essentially no rainfall from June through September. While the rainfall in Bordeaux is often perfect for maintaining vineyards without supplemental irrigation, most California vineyards require irrigation to carry them through the growing season. Fortunately, California is blessed with enough rain during the wet season to allow capture and storage for irrigation during the dry season.

In many ways, that is a distinct benefit to California, as we are not beholden to weather patterns that influence the growth of vine canopies or development or quality of our fruit crop. While irrigation is not required in some vineyard sites, due to a high water table or extremely deep and fertile soils, dry farming is essentially a misnomer, since non-irrigated vineyards that have an ample natural water supply are anything but dry!

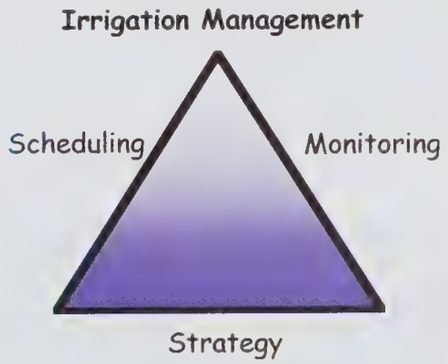
I have found, through experimentation and trial-and-error, that judiciously irrigated grapevines can produce intensely flavored and rich wines that are sought after by those operating "old-style" dry-farmed vineyards.

Irrigation articles often focus on one or two aspects of the topic, such as using ET or pressure "bombs." But given that irrigation is such a fundamental aspect of viticulture, it is more appropriately discussed in its entirety, which I will endeavor to do here.

Integrated irrigation management may be thought of as an interaction of three elements:

A. Irrigation scheduling,
B. Water status monitoring and,
C. Irrigation strategy.

All three components are required for proper wine grape irrigation, and all will be discussed in this article.



A. Irrigation scheduling

Irrigation scheduling is simply the practice of deciding how much irrigation to apply, how often. Blunders in irrigation scheduling can be made in several fundamental ways, including irrigating only on specific days of the week, cutting off irrigation during cool or cloudy weather, or by waiting for the vineyard to show signs of stress before pouring on a lake of water.

Scheduling of irrigation should be performed consistently and, to some extent, independently of vineyard moisture stress symptoms (see Section B). Stress symptoms should be used to *modify* irrigation schedules, not to determine actual irrigation applications.

When to start irrigation

Irrigation scheduling cannot begin until a specific starting date has been determined each season. Generally speaking, for regions that receive a sufficient amount (roughly 8 to 10 inches)

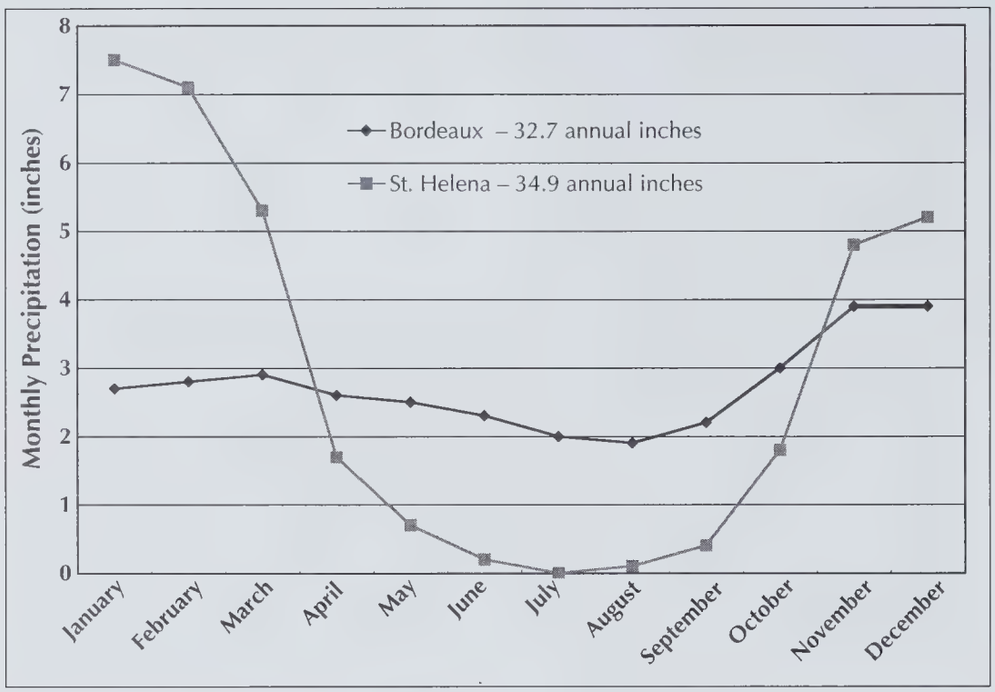


Figure I: Rainfall distribution comparison between Bordeaux and St. Helena. Data are 30-year averages from each region.

of dormant season precipitation to fill the soil profile to field capacity by early spring, we do not wish to begin scheduling irrigation until a sufficient amount of water has been extracted from the profile. In more arid regions, a large irrigation application is commonly applied prior to the time of budbreak to "fill" the soil profile to some extent, allowing for rapid vine growth early on.

However, it is not advisable to begin irrigation scheduling in the spring until the vines have extracted sufficient water from the soil so that their growth can be controlled. Exactly when that state is reached will depend on numerous factors, including whether or not the soil profile is filled to field capacity by winter precipitation; soil water-holding capacity; and presence or absence of cover crop. The latter factor will have a tremendous influence on water depletion rate in the spring, especially if a tall perennial grass crop is maintained.

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There are several ways to determine the trigger for irrigation initiation. They include:

- Monitoring soil moisture,
- Monitoring shoot elongation rate, and
- Measuring mid-day leaf water potential with a pressure chamber (see Section B [page 31]).

I have found that the pressure chamber is the most useful tool for this purpose.

A good rule of thumb is to begin the irrigation season when mid-day leaf water potential reaches –8 to –10 bars. The –8 bar end is used for white grapes or blocks that are more prone to water stress during the season. For most red varieties, –10 bars is used. The –8 bar end might also be chosen in less vigorous blocks, for which some additional shoot elongation is desired.

Some growers do not wish to invest in a pressure chamber. Fortunately, it is not absolutely necessary to have a pressure chamber in order to determine the irrigation trigger. Shoot elongation is highly correlated to mid-day leaf water potential (Figure II). Elongation ceases at a mid-day leaf water potential of about –9 to –10 bar. This provides an opportunity to determine the point of initiation at very low cost.

Mark out about 10 shoots throughout each vineyard block and measure the shoot lengths weekly. By using a spreadsheet to graph the shoot lengths, it will become apparent when shoot elongation slows down and, eventually, stops. This method will take a bit more trial and error than using the pressure chamber, but it is an acceptable second choice.

Be careful to look not only at shoot elongation *rate,* but also at the actual shoot length. If shoot elongation slows down before the shoots have attained sufficient length (about four-foot-long shoots or 20 to 22 nodes), it is imperative that irrigation be initiated to allow for continued growth. Once shoots stop growing, they will rarely restart unless excessive irrigation is applied.

While I suggest using the pressure chamber as a primary tool, the most intelligent method is to use soil moisture, shoot length measurement, and pressure chamber data together to arrive at this critical decision point.

How much water to apply?

Irrigation scheduling is like having a checking account. Viticulturists need to monitor how much is being withdrawn (by the vines) against the amount that is being deposited (by irrigation). The bank is actually the soil matrix, and we want to manage the "cash" flow such that we don't keep too much in the (low interest) account, while also being careful not to overdraw it.

The analogy to grapevines is that water availability in luxurious amounts results in excessive vine growth, and too little water in the soil creates excessive water stress in the vines. Mind you, a *little* water stress can be a good thing (regulated deficit irrigation, or RDI). This will be dis-

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Some indicators of excessive water stress are: leaf sun avoidance by folding and tighter angle with the petiole (Left), and shrivel of ripening berries (Right). These conditions are to be avoided.

cussed in Section C (May/June 2005 *PWV*). But first, let's discuss the deposits and withdrawals into our soil reserve.

Measuring water application

We can account for the amount of irrigation applied to a vineyard in several different ways. The important thing is to have the application units equivalent to withdrawal units. Traditionally, irrigation volume is expressed in inches of depth or in acre-inches of volume. It is more convenient to express drip irrigation amounts in terms of gallons per acre or hours of application. Since consumptive values are usually expressed in depth units, we need to convert them to more useful units:

1 acre-inch = 27,154 gallons (1)

To convert from inches to hours:

$$hours = \frac{inches \times 27{,}154}{\text{emitter rate (gph)} \times \text{emitters per vine} \times \text{vines per acre}} \quad (2)$$

or, from hours to inches:

$$inches = \frac{hours \times \text{emitter rate (gph)} \times \text{emitters per vine} \times \text{vines per acre}}{27{,}154} \quad (3)$$

Measurement of gallons applied, using an inline flow-meter, is probably the best method of irrigation application tracking. In that case, we would need to use the above equations to convert back and forth from inches. However, it is generally easiest to express irrigation application in terms of hours, since that is how we operate in the field. Using hours to track irrigation means that we need to translate consumption values from inches into hours using equation #2.

Estimating water consumption

Tracking applied irrigation is easy, since we have full control over it. On the "debit" side of the ledger, though, is water consumption. The best way to determine water consumption is the "ET" approach. ET is a friendly abbreviation for "evapotranspiration," which is a long word that simply means: water that evaporates either from the soil (evaporation) or from the plant (transpiration). With drip irrigation, almost all ET comes from the vine (because most of the soil surface is dry), but we still call it ET.

ET is highly weather-dependent and is increased by solar energy, dry air, and windy conditions. Solar energy heats up the vine's leaves and evaporation of water from leaves serves as a cooling mechanism. Wind increases ET by stirring up the humid layer of air that surrounds each leaf and mixing it into the dry surrounding air.

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Contrary to common belief, cool weather does not automatically imply low ET, since it is the capacity of the air to absorb additional water that most closely affects ET and not the air temperature itself. However, cool air holds less water than warm air, so there is generally a reduction of ET during cool periods, although cool temperatures at low relative humidity will still present a significant driving force for ET.

ET can be determined by many methods, but the most commonly used method is called "reference ET" or ET_o. Reference ET uses weather-measuring equipment to estimate a value of ET for a "reference crop" consisting of well-watered, mowed grass. For more information on ET_o, consult Reference #4.

Fortunately ET_o is readily available on a daily basis from many sources. In California, the CIMIS (California Irrigation Management Information System) is available at no cost (aside from tax dollars). Daily values can be obtained from the CIMIS and the UC Davis IPM websites. Use these resources to locate the nearest CIMIS station to your vineyard, and then stick with the same site consistently.

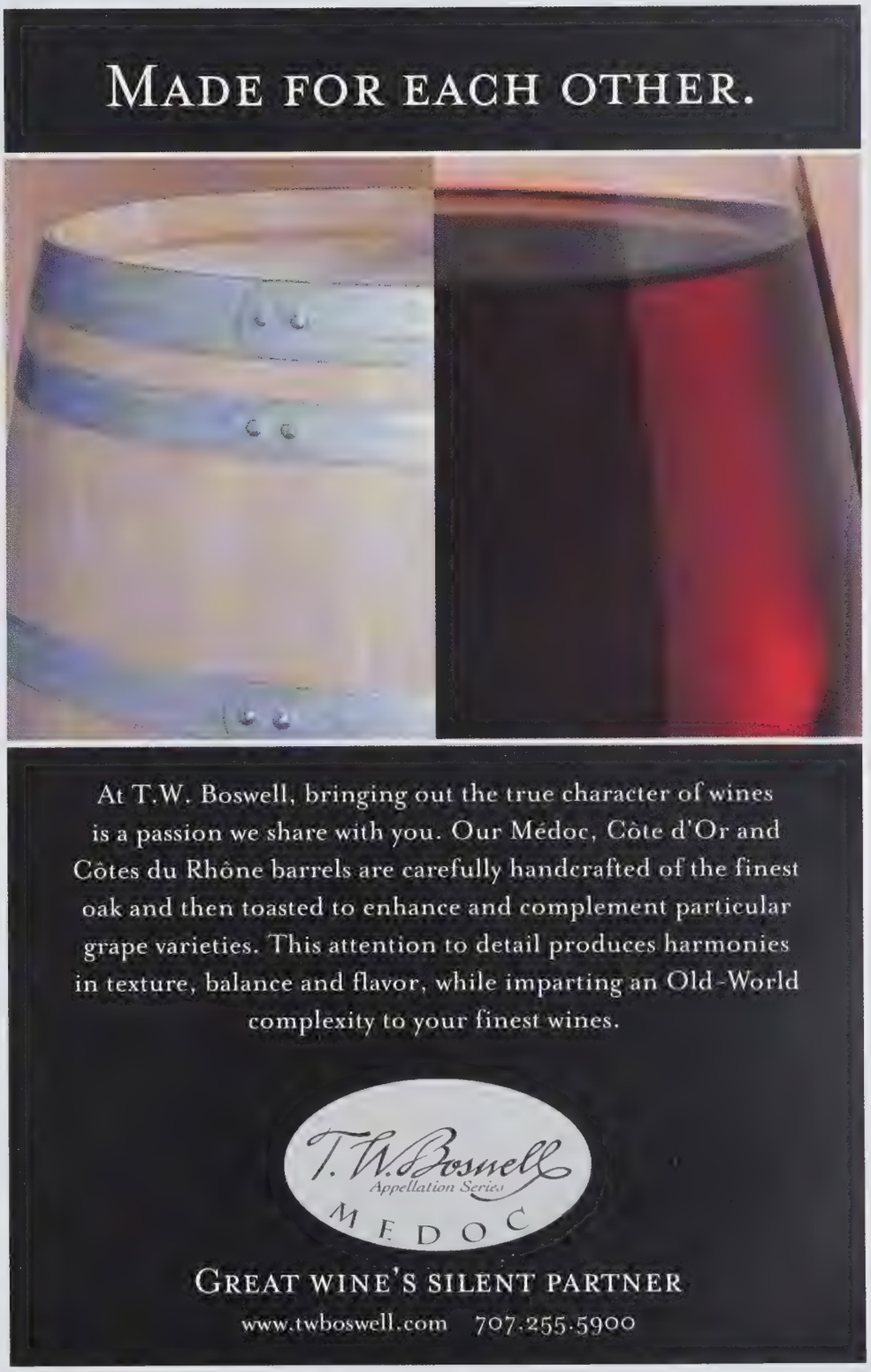
Other sources of ET_o include private weather stations (in your vineyard, if you'd like); weather station networks run by consultants; newspapers in some agricultural communities; and maybe even the winery that buys your grapes. ET_o is reported in inches or millimeters, which must be translated into gallons per acre or equivalent irrigation hours (equations #1 and #2 above) to match our accounting for applied irrigation.

But obviously we're not growing grass. We need to convert ET_o of the grass crop to grapevine ET, referred to generically as crop ET, or ET_c. To get ET_c values from ET_o values, we multiply ET_o by a "fudge factor" called the "crop coefficient," K_c.

$$ET_c = ET_o \times K_c \quad (4)$$

As grapevines are planted in rows and are more water-thrifty than grasses, the crop coefficient is always less than 1.0 (some fraction of full ET_o). Unfortunately, the crop coefficient is not a fixed number, and it is dependent mostly on vine size (or leaf area index). Since the leaf area index of a vineyard changes with time of year and trellis type, site vigor, row width, etc., K_c is not a very easy term to pin down.

The good news is that, after years of research into obtaining accurate crop coefficients, I've concluded that *consistency is more important than accuracy* when determining ET_c. The reason for this is that we can think of ET_c as an index, like the Dow Jones Industrial Average and S&P500 are to the stock market. We can raise or lower a second fudge factor (the management coefficient) in reaction to observations of vineyard water status (Section B) to compensate for errors and for vineyard management strategy.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Whatever model you use for K_c, stick with it year after year. Previously-published crop coefficients for grapes were determined for rather bushy California sprawl vineyards in the Central Valley and are, therefore, too high for the thriftier winegrape canopies that currently exist throughout the state.[5]

I have done some experimentation using direct methods of measuring vineyard ET and have found that K_c values of our vineyards are roughly 75% of earlier published values. Our K_c estimates are very similar to those determined by Larry Williams (University of California), so I recommend using his model for K_c.[6]

The discrepancy in crop coefficient values has, in my opinion, generated some confusion regarding desirable deficit irrigation levels for winegrape vineyards. While published results stating that deficit irrigation treatments of 60% of full ET_c have proven to produce desirable wine quality, we must be diligent in determining what crop coefficient model they were using.

If they were using "traditional" crop coefficient values, their ET_c was likely overestimated. That means that their 60% of full ET_c could actually translate into about 80%, using the new crop coefficient model. A grower who makes the error of applying 60% of full ET_c using the new crop coefficients might overstress the vineyard.

Some growers who have been using the old K_c model do not wish to switch to the new, lower values since that would change their management factors. That is fine, as long as they remember they're on the old model when contemplating modification of their irrigation strategy based on more recently published research. Again, consistency is more important than accuracy, and what has been working for a grower in the past should continue to work in the future.

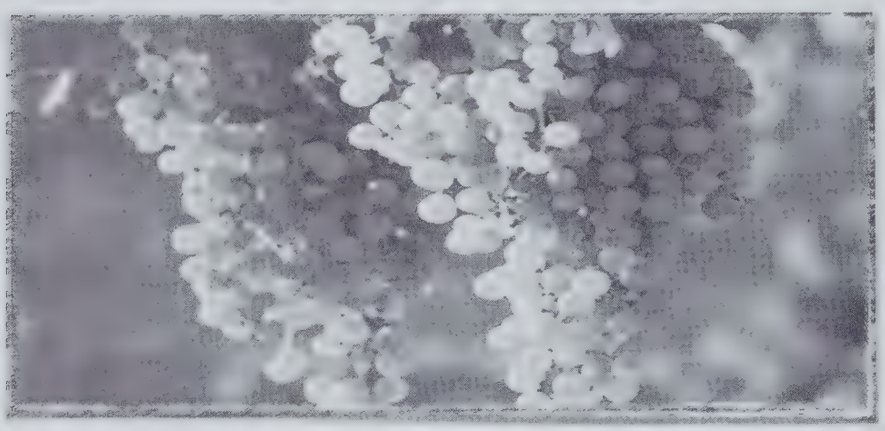
To aid in implementing an irrigation strategy, another factor, the management factor (K_m), is used in addition to K_c. Our ET equation now becomes:

$$I_a = ET_o \times K_c \times K_m \quad (5)$$

I_a is irrigation to be applied in units of inches (or whatever units ET_o is in). The K_m value is chosen to reflect the percentage of ET_c that is to be applied (80% of ET_c equals a K_m of 0.8). Km can be changed at veraison for pre- or post-veraison deficit strategy.

Any errors in ET estimates can be absorbed into the K_m since it is set arbitrarily and experimentally. It is very important that records be kept from year to year so that the K_m value can generate a consistent ET-based schedule.

To make scheduling easier, crop coefficient and management coefficient values can be embedded in a spreadsheet or database irrigation scheduling program. Then, the only inputs needed on a daily basis are ET_o and hours irrigated. Irrigation requirements are



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determined by subtracting hours irrigated from the hours of ET_c.

One does not need to go back to the beginning of the irrigation season to determine how much to irrigate the next day or week. It is sufficient to use between one and two weeks of irrigation and ET_c history (using a sum of ET_c and a sum of irrigation hours over that same time period). For those who do not wish to create their own computer-based scheduling system, there are several references for irrigation scheduling software on the CIMIS web site.

How often to irrigate

While the most critical (and difficult) part of irrigation scheduling is determining the irrigation quantity required, it is also important to know how often irrigation should be applied (irrigation frequency). In other words, if a ET_c model indicates that 18 hours are needed in one week, do we apply three six-hour sets, two nine-hour sets, or a single 18-hour set?

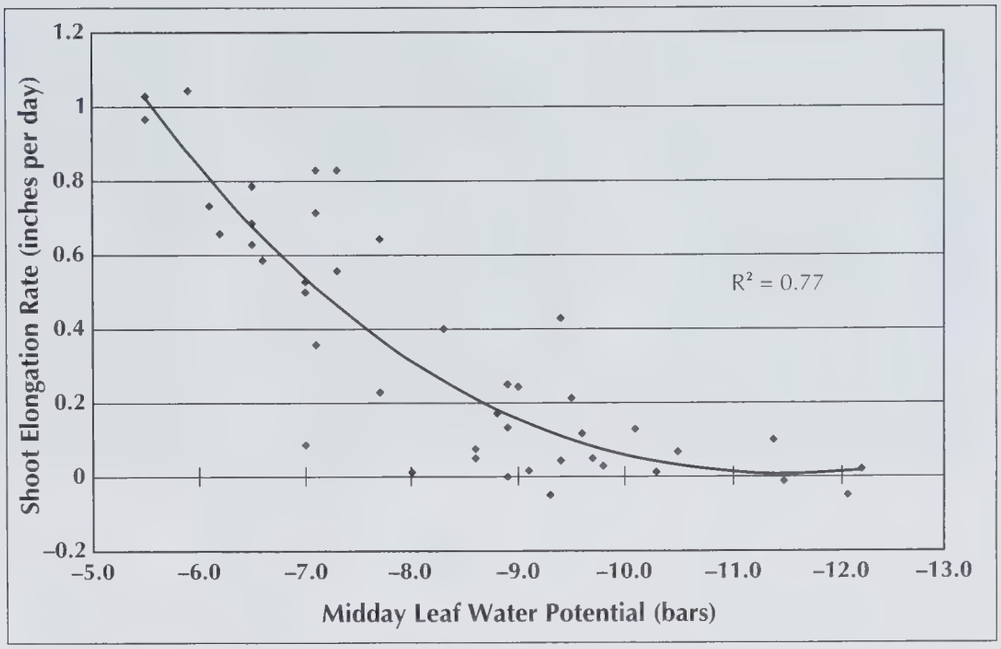

Figure II: Shoot tip elongation rate plotted against midday leaf water potential. Measurements were taken in 2003 in Sonoma County vineyards for three varieties (Merlot, Cabernet Sauvignon, and Pinot Gris). Regression line indicates a strong relationship between shoot elongation and midday leaf water potential, with elongation ceasing at about -10 to -11 bars.

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Figure III: Shoot tip ratings of vine water status. Fig. III-1: Active shoot growth; tendrils reach past growing tip; basal tendrils turgid; Leaf Water Potential (LWP) > –8 bars. Fig. III-2: Slowing shoot growth; tendrils even with growing tip; basal tendrils turgid; LWP –9 to –11 bars. Fig. III-3: Ceased shoot growth; leaves extend past growing tip; basal tendrils turgid to slightly droopy; LWP –12 to –13 bars. Fig. III-4: Dead or missing shoot tip; basal tendrils droopy or falling off; leaf-petiole angle becomes smaller; LWP –14 to –15 bars.

While water use (ET_c) is controlled by the vine and weather conditions, irrigation application is limited by soil properties. Selection of irrigation duration and frequency is highly dependent on soil water-holding capacity.

Soil texture plays a large part in soil water-holding capacity, as does soil (and rooting) depth. Generally speaking, sandy soils have low water-holding capacity per foot of depth, while clay and loam soils have high water-holding capacity. Given any requirement for irrigation, soils with low water-holding capacity will have to be irrigated with lower volumes more frequently than soils with high water-holding capacity (which can be

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irrigated with greater volumes less frequently).

Irrigating with a volume beyond the water-holding capacity of a soil will waste water through percolation below the root zone or through run-off. Approximate values of water-holding capacity can be found in references,[2] but with drip irrigation, it is difficult to determine how much soil volume is wetted, since water is applied from a point source and not uniformly across the surface.

Some irrigation scheduling systems use a soil-water content approach to trigger each irrigation event, but with drip irrigated vineyards at Gallo of Sonoma, we have found this approach to be difficult and unnecessary with drip-irrigated vineyards. However, the soil-water content approach more directly addresses the issue of irrigation frequency, as irrigation events are triggered by soil-moisture content levels.

A better method is to monitor midday leaf water potential with a pressure chamber daily, following an irrigation event. Examine both weak and stronger sections of a vineyard to see if vines are becoming temporarily stressed between irrigation events in weaker areas. If so, reduce the time between irrigations a day or two while cutting back on the volume accordingly.

It becomes less important to monitor soil-moisture profiles and/or day-to-day vine water status once a good feeling for the irrigation constraints is obtained.

Irrigation efficiency and uniformity

Irrigation duration and frequency directly influence application efficiency and, in the case of hillside vineyards, application uniformity. There is frequently confusion over the two terms: uniformity and efficiency. They are not synonymous.

Uniformity refers to the equal distribution of irrigation volume throughout a vineyard being irrigated. In other words, if application uniformity is perfect, all vines would receive the same volume of water.

On the other hand, efficiency refers to the amount of applied water that is available for uptake by vines. If efficiency is perfect, all water applied during each irrigation event will be available for uptake.

In reality, it is not possible to achieve perfect uniformity or perfect efficiency. But we need to be aware of these factors so that we can maximize them.

Application nonuniformity is common in hillside vineyards due to delays in system filling at startup and system drainage at shutdown. It can also arise from variation in emitter discharge rates due to pressure differences and/or clogging, although good system design and maintenance should minimize that problem. (Refer to Reference #1 and #3 for more information on system design influence on irrigation uniformity).

In order to maximize uniformity, irrigation should be held off until the

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required application is of sufficient duration (six to eight hours), that the fill and drain times of the system are only a small percentage of the total irrigation duration.

Application efficiency is defined as the percentage of applied water that is available for vine uptake. While efficiency is reduced by evaporation from the soil surface, this loss is minor with drip irrigation. The primary cause for reduced efficiency is loss due to runoff and/or deep percolation below the root zone.

Soil can be thought of as a sponge

Applying water faster than it can be absorbed results in surface runoff. As the soil becomes saturated at deeper and deeper levels during an irrigation application, its infiltration rate decreases, potentially resulting in water runoff from the target location. Additionally, applying more water than the soil column can hold in its pores results in deep percolation like seepage out of the bottom of a saturated sponge.

Water that percolates below the root zone can move laterally below the ground (especially on hillsides), resulting in areas deficient in water and areas with surplus water. This wastes water and can result in groundwater contamination, especially with regard to nitrates that move readily down the soil profile. Furthermore, the differential quantities of water at the top versus the bottom of the hills will increase nonuniformity of vine growth.

As for irrigation efficiency, vineyard and soil spatial variability must be considered. Weak areas in vineyards are often caused by gravel or sand streaks, or by shallow soils on hilltops, or other changes in soil texture or depth such as those that occur during land development. The weakest or shallowest soils need to be focused on when determining the maximum irrigation duration, since any irrigation beyond what can be held in the weak zone may result in vineyard nonuniformity.

A common mistake is to apply more water to weak areas by adding extra emitters. However, weaker areas of a vineyard actually consume *less* water than stronger areas due to less foliage being present, so extra watering does not make sense.

Our goal is to produce and maintain vineyards of uniform vine size, so we need to apply the same amount of water throughout the vineyard, regardless of soil water-holding capacity.

The the best way to manage around variability is to irrigate so that the regions of low water-holding capacity are not irrigated beyond what they can hold. This can be accomplished by irrigating with shorter, more frequent irrigation events that maintain more consistent moisture availability in the weak soil areas while providing the same quantity of irrigation to the entire field.

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In general, longer, less frequent irrigation events will reduce irrigation efficiency, while increasing application uniformity. This contrasts with shorter, more frequent irrigation events that increase irrigation efficiency while decreasing application uniformity.

When using drip irrigation, it is important not to extend the duration between irrigation events too long, no matter what the goals are for deficit irrigation (see Section C). After winter rainfall is depleted and the remaining soil water comes from irrigation, there is only a small water reservoir available to each vine, and ready water-availability during periods of hot weather is crucial to protect vines against heat damage.

It is difficult to state, as a rule of thumb, how long is "too long" between irrigation events, as it is highly dependent on soil characteristics. "Too long" could range from a couple of days to a couple of weeks. Use soil moisture probes or, as discussed earlier, pressure chamber measurements to evaluate the drying cycle between irrigation events and learn about your vineyard.

Changing weather patterns are common in coastal grapegrowing regions, and cool weather should not be seen as an excuse to cut back on water. Remember that water consumption is determined less by temperature than by humidity, sunlight, and wind. Keep to your ET_c model even during cool weather or you will be caught short during the heat wave that follows!

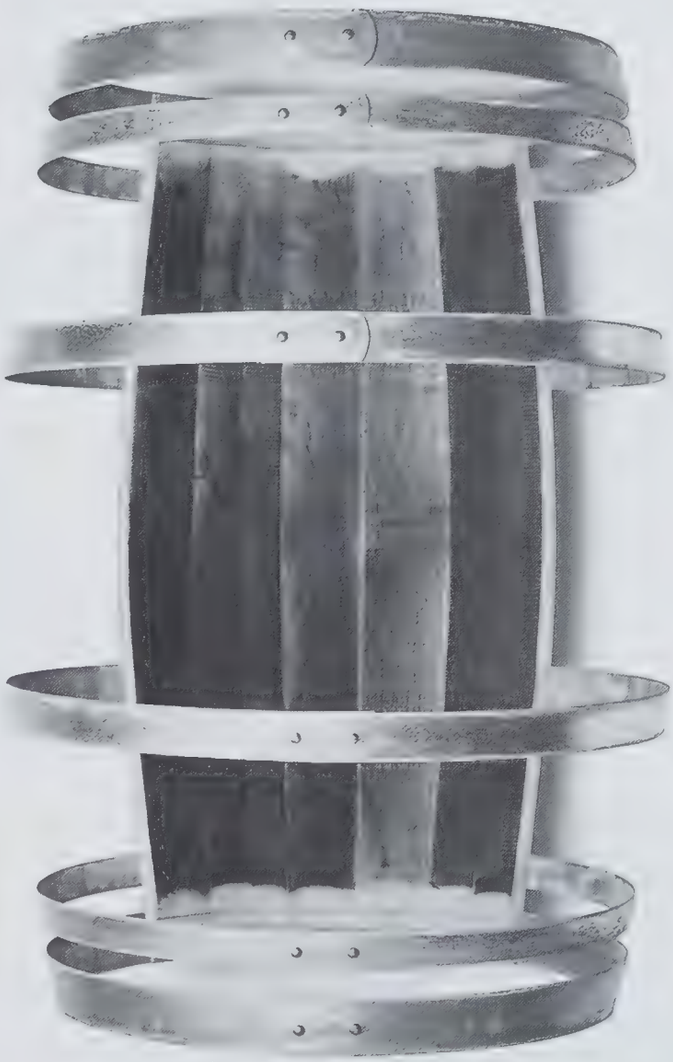
B. Monitoring vineyard water status

Irrigating without monitoring vineyard water status is like driving a car blindfolded. That analogy may be tired, but it's very fitting. In irrigation scheduling, our best efforts at determining water consumption through ET_c are still an approximation. We need to watch the vineyard to determine its response so we can make corrections, if necessary, during the season and in seasons to follow.

While many years of experience will allow a vineyard manager to expend less effort on vineyard water status monitoring, some monitoring will always benefit vineyard health and support an irrigation strategy (see Section C, May/June 2005 ***PWV***).

Soil moisture monitoring is a traditional way to measure water status of agricultural systems. But in most agricultural applications, the soil moisture is maintained close to field capacity. By contrast, in winegrape growing we do not always want to maintain a high water status of vines (see Section C).

Furthermore, in drip-irrigated vineyards, the wetted soil volume is usually discontinuous and, as a result, there is great potential for measurement uncertainty, depending on location of the sensor with respect to emitter position, not to mention the variability in soil properties through-



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out any vineyard block. Consequently, it is generally advantageous to monitor the vines rather than the soil.

Hence, this discussion will focus primarily on vine monitoring using instruments and visual assessments. But first, a few points about soil moisture methodology.

Soil moisture measurement does have its place in drip irrigation systems. It can be used early in the season after winter rainfall has uniformly wetted the soil profile. That is probably the single most useful time of the season for soil moisture monitoring. Irrigation initiation decisions can be based on waiting for soil moisture levels (either water content or water potential) to reach a specified threshold after being depleted from winter rainfall storage.

In regions where the soil profile is not completely filled by winter rainfall, as on the north coast of California, soil moisture monitoring is useful in gauging when to commence irrigation or how much irrigation is needed to refill the soil profile by budbreak. But remember that once drip irrigation has begun, the readout of the instrument no longer represents the entire horizontal extent of the root zone of the vineyard.

Instruments that measure soil water content include the Neutron Probe, Time-Domain Reflectometry (TDR), and Capacitance (dielectric) Probes. For measuring soil water potential (suction pressure), soil-moisture blocks and tensiometers are available. All of these instruments have some associated error. It is best to consider these measurements as site-specific — each site should be "calibrated" independently. This is yet another strike against soil-moisture measurement. For more discussion about soil-moisture monitoring methods, consult references #2 and #4.

Vine water status monitoring

There is no better indicator of how your vineyard is doing than the vines themselves. I've found that the pressure chamber is, by far, the preferable method for monitoring vine water status.

A pressure chamber (also called "pressure bomb") should be available to most winegrape growers, either owned or through a service. The pressure chamber is a portable, relatively low-tech and low-cost instrument that measures water potential of the vine at the location it is sampled (usually the mid-shoot leaves).

What is water potential? To understand it, you must first understand that water is not pushed through the vine, but is sucked through the vine. Suction arises in the leaves, where liquid phase water evaporates. Recalling the discussion about ET, the dryer the air surrounding the leaves, the greater the evaporation rate is. The water suction force is transferred throughout the vine that, in effect, has a continuous column of water from roots to the leaves

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through the xylem, or water-conducting vessels.

Soil holds onto water like a sponge and, as happens with a sponge, it is more difficult to extract water as the soil becomes dryer. Hence, there is a tug-of-war between the soil and the atmosphere, with the vine stuck in between like the rope. So, the dryer the soil becomes and/or greater the "evaporative demand" of the air becomes, the stronger the suction on the water column will be.

Suction can be expressed in units of pressure. Actually, negative values are used because suction is synonymous with negative pressure. Commonly, water potential is expressed in units of bars (1 bar is approximately equal to one atmosphere).

In scientific journals, Megapascals (MPa) are most commonly used. Don't let that throw you off; to get bars from Megapascals, just multiply by 10. It is even more common for people to leave off the negative sign from the bars in casual conversation. That is technically incorrect but since everyone does it, it is acceptable. Larry Williams provided a good overview of the pressure chamber in a previous *PWV* text.[6]

The beauty of the pressure chamber is that it is easy to learn, requires no power source, and is portable. Just mount it to an ATV and take it where you want to go. Measurement is made by sampling — cutting off — an exposed, fully expanded leaf. Before sampling, though, it is important to enclose the leaf blade in a plastic sandwich bag immediately before it is removed. This crucial step is often disregarded, and can create substantial measurement error if not done.

A leaf is cut off with a razor blade and placed in the chamber, bag and all, with the cut end exposed. The chamber is slowly pressurized until the petiole sap just reaches the cut surface. If done correctly, the pressure in the chamber that is read off the gauge is equal to the suction that was in the xylem vessels before the leaf was removed. It takes some practice, but it is a skill that can be learned by almost anyone.

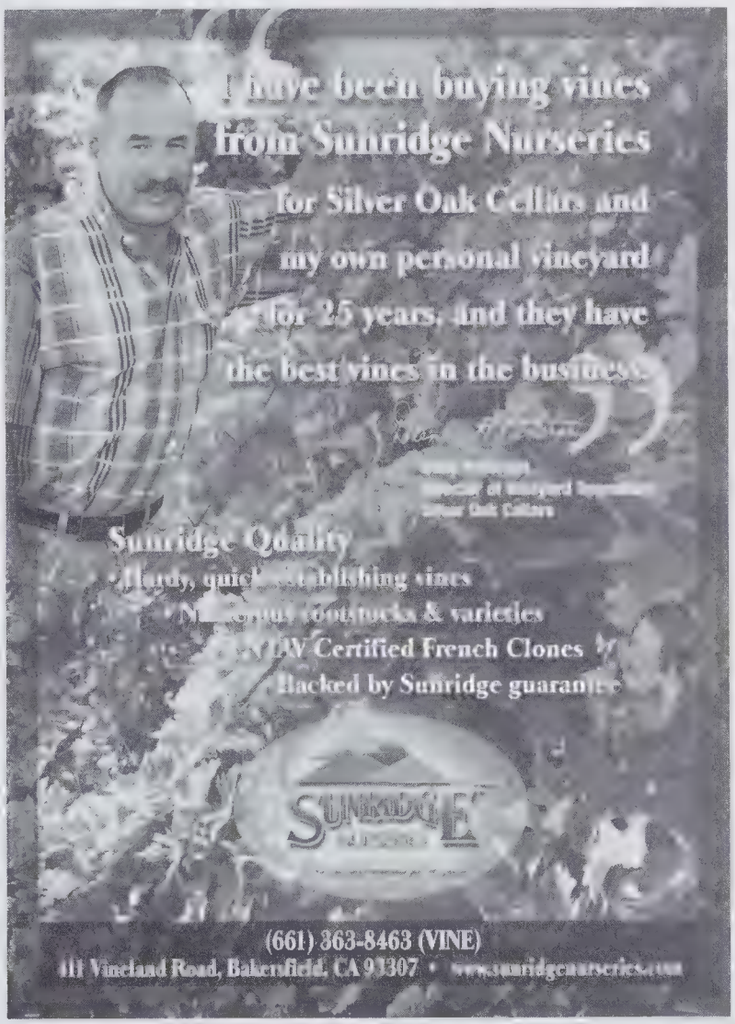
Measurements should ideally be taken about mid-day. I have found, however, that the hours of noon to 3:00 work well for reliable readings. The main thing is to do it — and do it regularly.

It is difficult to make general specifications about interpretation of water potential measurements, although strategies will be discussed in Section C. As a general guideline, the following may be used:

Greater than –10 Bars	No stress
–10 to –12 Bars	Mild stress
–12 to –14 Bars	Moderate stress
–14 to –16 Bars	High stress
Less than –16 Bars	Severe stress

Remember that since these are negative numbers, "greater than" means "less negative than" and "less than" means "more negative than."

While the pressure chamber is an easy-to-use instrument, there are a few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caveats required for accurate measurement, not the least of which is making sure to bag the leaf on the vine before removal. Vine water status is likely to vary considerably throughout a vineyard block. Be sure to sample numerous locations within a vineyard to get either a composite value for the block or to map out zones of similar water status.

As a rule of thumb, sample at least one location per acre for very small blocks (less than five acres) down to one location per five acres for larger blocks (about 100 acres). At each location, take measurements on two leaves. If they are within 1 bar of each other, log the average and move on to the next site. If not, take a third measurement. If there seems to be an outlier that differs more than 2 bars from the other two, discard that measurement.

Refrain from making measurements on abnormally hot and dry (or windy) days, when even well-irrigated vines will produce measurements that suggest they are stressed. Conversely, measurements taken on cloudy or foggy days will give meaningless values.

At Gallo of Sonoma, we generally wait at least one hour after the fog lifts to begin pressure chamber measurements and do not take readings when it is even partly cloudy.

Finally, realize that water potential is a measurement of the suction force in the vine. Vines have built-in drought resistance whereby they close their stomatal pores in the leaves when water stress is imminent. Water flow decreases when stomatal closure occurs and that tends to decrease the suction force. This situation could be misread as a non-stressed condition.

Measuring stomatal conductance requires the use of an instrument called a porometer, which is a fantastic tool but hardly practical for a grower. I suggest, to avoid misreading a highly stressed condition, that frequent (at least weekly) pressure chamber measurements be made in addition to careful attention to visual symptoms.

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Continued on page 79

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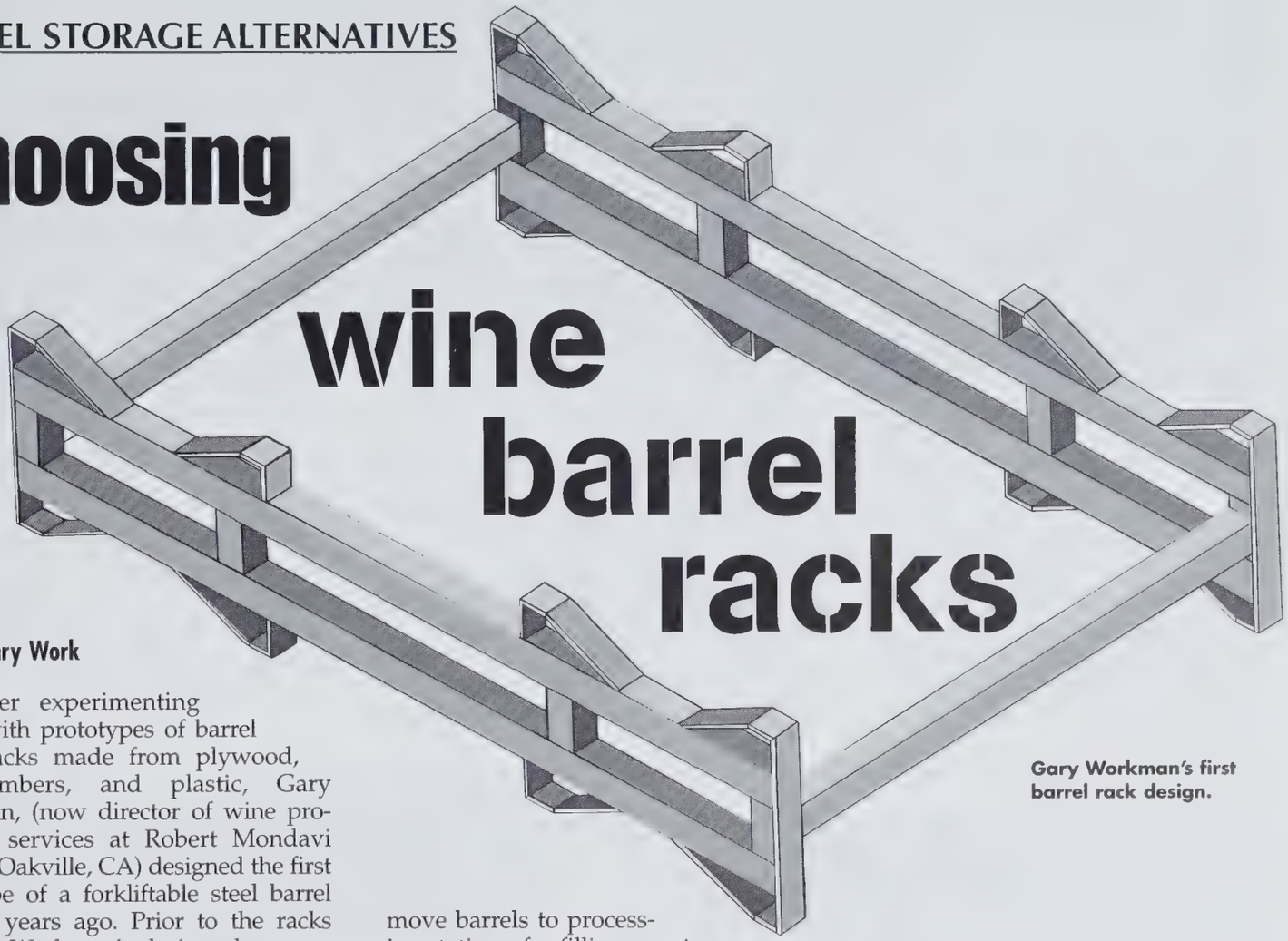
BARREL STORAGE ALTERNATIVES

Choosing wine barrel racks



Gary Workman's first barrel rack design.

BY Henry Work

After experimenting with prototypes of barrel racks made from plywood, timbers, and plastic, Gary Workman, (now director of wine production services at Robert Mondavi Winery, Oakville, CA) designed the first prototype of a forkliftable steel barrel rack 30 years ago. Prior to the racks made to Workman's design, there was no real innovation in wine barrel storage; barrels were stored on stationary racks or stacked pyramid-style.

Several manufacturers have essentially duplicated the basic portable steel barrel rack design, while implementing modifications and manufacturing techniques to make racks more practical, durable, and aesthetically pleasing to wineries.

Portable steel barrel racks evolved out of the demand to process increasing numbers of barrels, as wineries shifted from ageing in large wooden tanks to smaller cooperage, and from the desire for increased flexibility over what pyramid-stacks or stationary storage racks provided.

As these transformations occurred, wineries had to decide whether to move barrels to processing stations, for filling, emptying, and washing, or to process the wine in barrel stacks. These decisions have shaped the cellar organization and production facilities of many wineries.

Changes in rack design are limited by constraints in the existing washing, filling, and associated conveyor systems. Further changes in these processes may someday prompt new rack designs.

With at least 10 brands of barrel storage systems available (see list at end of text), winemakers have many unique choices to meet particular needs. Racks are configured in a range of styles — from simple chock-like systems to the ubiquitous two-barrel and four-barrel square-tube racks to new rack-on-rack systems and, finally, to elaborate, semi-permanent modular systems holding individual barrels on wheels.

Portable steel barrel racks are now designed for almost any barrel style. Larger openings between barrels allow for topping and racking in place, and four-barrel racks boost productivity in large wineries. This article will examine the attributes of the various available style(s) to help choose the right racks for your operation.

Storage systems have been designed to meet generic winery needs of improving productivity, reducing the need to lift barrels, improving barrel access, and flexible stacking. The current systems can be subdivided to forkliftable models and modular systems.

Forkliftable barrel racks

Two-barrel, portable steel barrel racks have become very popular in many U.S. wineries. The original racks were designed for 225-liter barrels, but over the years, other sizes, capable of accommodating small kegs to puncheons, have been built to meet particular needs of a winery.

While early racks had only a few inches of vertical space between barrels to minimize the height of a stack, models are now available with seven inches of space between the top of one barrel and bottom of another. This allows for filling, topping, and clean-

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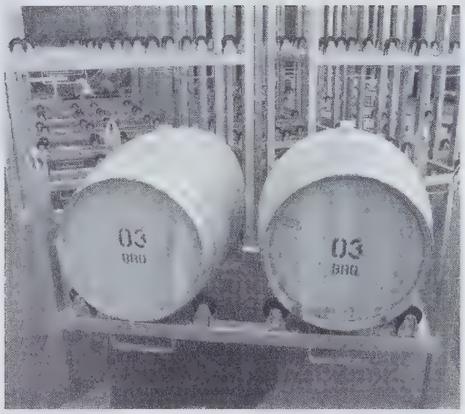
Henry Work has been in the cooperage industry for 26 years, serving in positions at Barrel Builders in Napa Valley and as general manager of Canton Cooperage in Kentucky. He currently consults for wineries on issues of cooperage and winery management.



BarrelMaster rack system for two barrels

ing. Most models now have double crossbars for extra strength, are powder-coated, and are available from at least six manufacturers (Acufab, G.W. Kent, Quality Racks, Titan-Rack, Topco, and Western Square).

As the majority of two-barrel racks are based upon the same design and size, the differences between them are subtle. These differences include:

- Size of forklift opening,
- Supporting cradle design and how much surface area supports the barrels,
- Crossbars and whether the rack can be pallet-jacked from the side.

Options in the supporting cradle design include: the "eastern" saddle (most common for two-barrel racks), and "western" saddle (common on four-barrel racks), which creates a somewhat springy stack that allows barrels to settle into place, available from Topco or Western Square. Topco also offers a TopChock® saddle. Choices from G.W. Kent include a block saddle and the V-shape saddle.

Several manufacturers, including Titan-Rack, Topco, and Western Square, offer a similar rack for four barrels. But a winery needs more aisle space, a large forklift capable of lifting 10,000 pounds, and about 3,000 barrels to make efficient use of this style.

Lining up barrels on racks, especially into six-high stacks, takes a good bit of skill. To help this problem, two rack companies from Australia (RGB and Barrel Master) and one from Spain (Sagarte) offer, through American distributors, racks that stack on top of each other (rack-on-rack) instead of rack on barrel. (Note: Sagarte is a new entry into the U.S. rack market and was analyzed by the author only through website photos.)

A big advantage to these racks is in eliminating the need to match barrel sizes, both on an individual rack and within a stack. Commenting on the forklift driver's skill required to stack barrels evenly on conventional racks, Cameron Vawter, assistant winemaker at Diamond Oaks (Oakville, CA) notes that new rack-on-rack systems are "idiot proof," because stacking racks upon one another is easier than stacking racks onto barrels.

The Barrel Master and RGB rack-on-rack systems combine the advantages of conventional racks with a more modular system. However, both Vawter and Cameron Frey, associate winemaker at Ramey Wine Cellars (Healdsburg, CA), note the difficulty of

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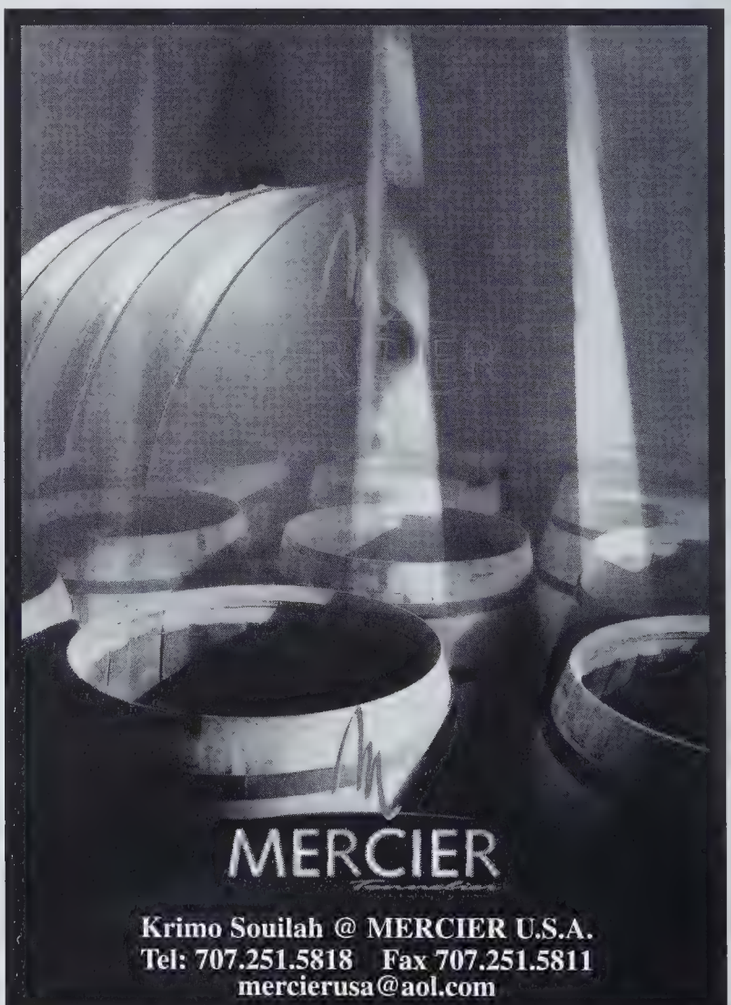

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Vingenuity barrel safety systems	www.vingenuity.net

moving barrels in and out of the racks with forklift forks due to permanent upright corner bars.

Rack-on-rack systems require about the same footprint as conventional racks, but need wooden shoring or optional side-fork pockets to pallet-jack from the side.

An equally important issue is storage of the racks when not in use. In general, two-barrel racks store compactly, but require manual stacking or expert forklift driving to alternate the orientation. The new rack-on-rack systems are also stackable. Sagarte is the most compact but requires removing vertical members.

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Modular racks

When using racks, wineries use various combinations of two approaches: processing the wine while the barrels are stacked on racks or unstacking barrels for any activity. Comparing the efficiency of these two systems is beyond the scope of this article, but there is something to be said for a modular rack system where each barrel can have individual attention. Two modular systems attempt to address this by supporting each barrel on wheels for easy rotation — OXO and Sagarte.

With the OXO Line and Sagarte semi-permanent, modular systems, each barrel is isolated on wheels within the framework. This enables winery workers to do much or all of the work, including lees stirring and cleaning, in place. The systems are assembled in place, but do not have to be attached to the floor or walls. Barrels can also be put on wheels with both the Barrel Master and Sagarte rack-on-rack systems.

Ivo Jeramaz, vice-president of vineyards and production at Grgich Hills Cellar (Rutherford, CA), has more than 700 barrels on the OXO system. He likes the fact that, with each barrel supported on its own wheels, the lees may be "stirred gently without oxidation caused by opening the bung to insert a stirring wand."

Barrels of Grgich Hills Chardonnay are rotated 180°, and the lees, now at the "top" of the barrel, are allowed to gently resettle to the "bottom." This is done twice each week. In blind tastings of Chardonnay that has been stirred with a wand compared to that made by rotating the barrels, Jeramaz prefers wine from the rotated barrels. "It has less oxygenation and tastes fresher," he explains.

Jeramaz has set each two assemblies of the OXO racks 48 inches apart to allow removal of individual barrels. With the help of small stepladders and catwalks that are placed at the top of the third barrel level, every barrel can be processed in-place. The Moog system is used for washing barrels in place, which Jeramaz reports thoroughly removes tartrates from barrels. This leaves just a few milliliters of water which can be easily dumped out by rotating the barrel.

For winemakers and cellar masters who prefer pyramid stacks, Topco and Western Square offer a steel cradle that is potentially safer than wooden chocks in an earthquake.

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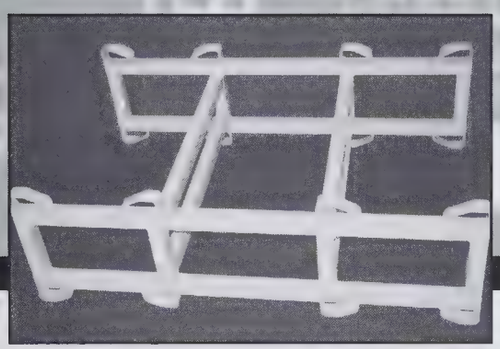

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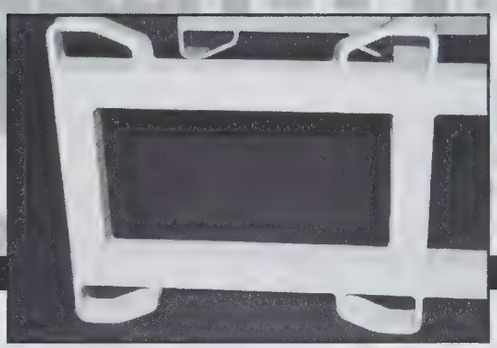

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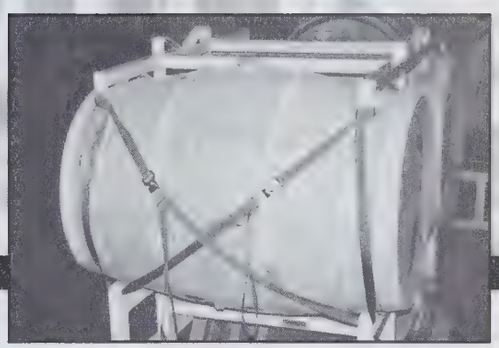

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The Topcap helps to protect wine barrel stacks during an earthquake by restraining the top barrels in a stack to their racks. Top barrel ejection is one of the more common consequences of a seismic event. This new technology was developed in collaboration with Josh Marrow based on research he conducted at CSU San Luis Obispo. A U.S. patent, No. 6050,538, was granted for all top barrel restraint devices.

Topco Inc.

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Vingenuity barrel safety system includes Cradle Extender (white clip-on devices attached to cradles of rack above), to keep barrels from rolling out of supporting rack-cradles. Rack Positioning System (brown nail-on devices on top of barrel) attaches to top and bottom of barrel to ensure vertically-straight stacks, and improved resistance against rack sliding, walking during an earthquake or aggressive barrel handling.

Organizing by barrel lots

While barrels from most cooperages are fairly standard in size, mixing brands poses a constant problem for cellar workers. This is especially true on two-barrel racks and, to some extent, on four-barrel racks. Even a barrel only a few millimeters in diameter larger or smaller than its rack mate can throw a whole stack off a vertical axis.

The idea of containing a barrel within its own rack has appeal for some winemakers, especially those working with numerous barrel brands for the same wine or wine lot. Vawter and Frey have "trialed" the rack-on-rack styles and note that, because of the rack-on-rack configuration, differences in size between barrels become negligible. These rack-on-rack systems and the modular systems support each barrel independent of other barrels.

While initiated by Topco, several companies now offer racks in various colors in order to differentiate between barrel lots or to coordinate a client's barrels in a custom crush facility. But Vawter doesn't like dark colors, because forklift drivers have complained of difficulty seeing them in a densely stacked cellar where overhead lighting is sometimes obscured. Forklifts should be equipped with lights for just this reason. Forklifts at Diamond Oaks have a third adjustable light to assist operators.

How to store a single barrel of wine? Titan-Rack, Topco, and Western Square offer an add-on cradle that fits in the middle of a rack between the welded cradles, allowing a single barrel to remain stationary as the rack is maneuvered into position on top of a stack. Topco offers a "Howdah" rack for a single barrel that resembles an Indian Elephant saddle.

Rack-on-rack systems can hold one barrel. Other rack modifications hold winery supplies, such as a topping tank, and can be stored on top of barrel stacks in a small winery where space is at a premium.

Organization by weight

Many wineries purchase thin-stave (21 to 22 mm) barrels to aid in wine maturation. The barrels are a spin-off of the Chateau style of Bordeaux barrel, which was intended to remain within a winery and be stacked only two- or three-high at the most.

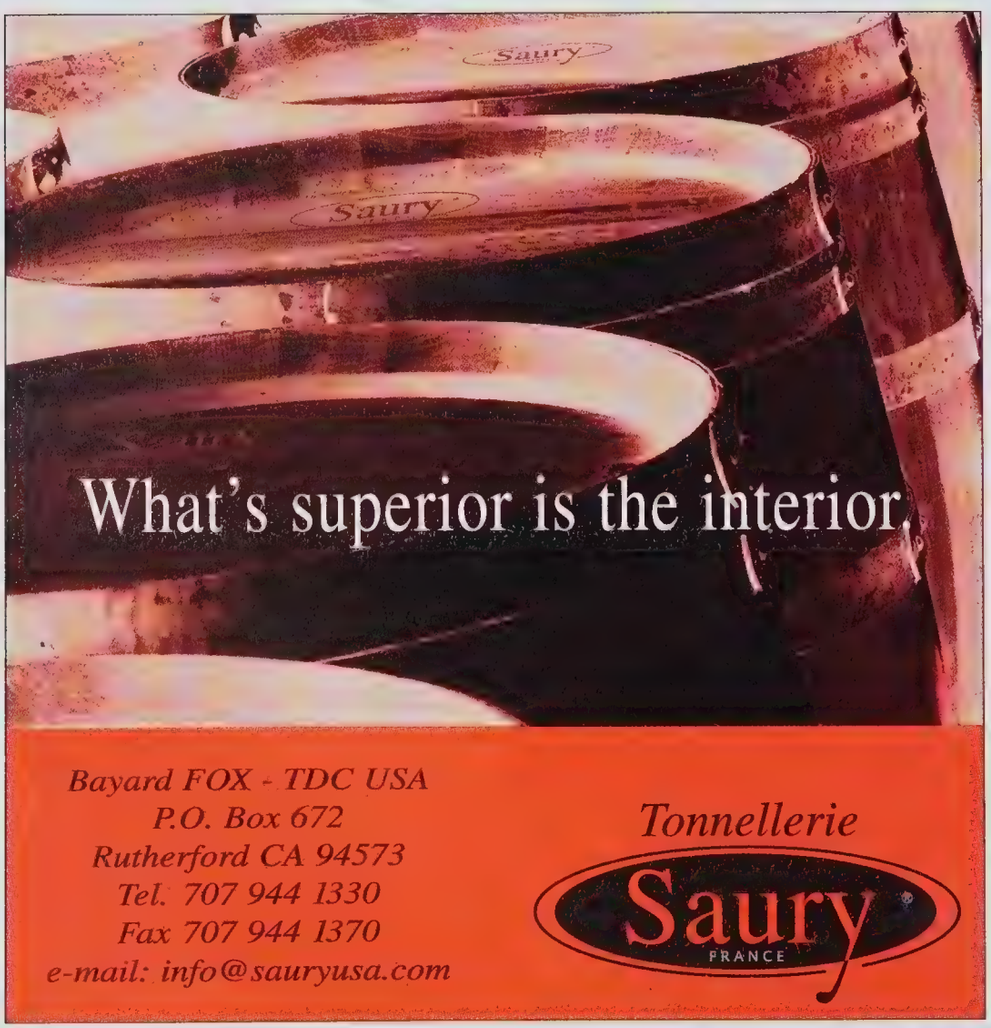
The transport barrel (27 to 28 mm thick staves) is a sturdier cousin to the thin-stave barrel. While also not specifically designed for barrel racks, it can withstand the weight pressures of taller (six-high) stacks. In any rack-on-barrel system, thin-stave barrels should never be on the bottom with full barrels above.

Thin-stave barrels should not be stacked six-high full of wine or rotated 45 degrees when stacked. The rationale for this precaution is that the pressure on a rotated, thin-stave barrel on the bottom of a stack can cause the head boards to shift, resulting in a leak. These recommendations also apply to barrels that have been shaved and to those with grooved staves. Rack-on-rack and modular systems negate these concerns.

Organization — access to barrels

Before the general use of barrel racks, when barrels were stacked in pyramids, the philosophy was to bring the work to the barrels. This approach came with the inherent limitations of cleaning in-place and the difficulty of pulling a leaking barrel for repair. Racks changed that, allowing barrels to be brought to cleaning and filling stations, thus affording easy access to any barrel with a problem.

Ultimately, if you find you are not inclined to forklift barrels down out of



stacks for processing, then perhaps you should consider modular systems that allow access to barrels in the stacks. You can also reorganize portable steel barrel racks or rack-on-rack stack spacing to allow room for a tall, narrow ladder to provide the same access. (Contact Western Square for information about Stokes Ladders.)

Two considerations for spacing are the slope of the floor and the space available between stacks. When possible, orient the long length of the rack with the slope of the floor. Where the slope is excessive (as often happens in facilities that were built for operations other than wineries) and stacks tilt out of vertical, racks can be fabricated to compensate for the angle.

For restrictive cellar situations — such as an excessively sloped floor — or when frequent access to barrels is needed but forklifting them down and back takes too much time, consider increasing the space between stacks to allow access by movable ladders. This could be a safer alternative, with possible savings of gas and reduced forklift wear-and-tear achieved as well.

Safety — operations and earthquakes

Josh Marrow, president of Vingenuity Inc. (San Francisco, CA), has extensively researched damage in wineries caused by earthquakes for almost 10 years. His most recent report, "Lessons learned on the fault-line" (May/June 2004 *PWV*), summarized many of his findings following the December 2003 San Simeon earthquake that damaged some Central Coast wineries.

Marrow documented actual earthquake performance and correlated it with the results of his research. Based on the results, he developed several rack attachments that minimize barrel and rack movement during an earthquake, incorporating enhancements to the basic barrel-on-rack design. His wine industry-supported research resulted in many recommendations for safer winery operations in general and specifically for earthquake safety.

Gamajet/Western Square Barrel Wash System utilizes a new Gamajet Barrel Blaster HD cleaning machine and a customized Western Square wash rack to provide heavy-duty cleaning performance without the need to lift barrels.

Observations from Marrow's research and recent damaging earthquakes established that, under earthquake shaking or aggressive handling, barrels can roll out of their cradles, and barrels and racks (in a stack) are likely to slide and walk atop one another, potentially collapsing the

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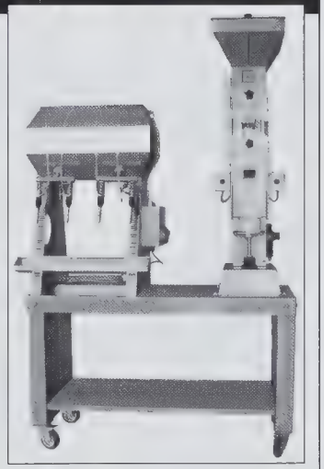

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stack. After completing shake table research, Marrow worked with numerous California wineries to develop add-on safety devices (rather than redesign barrel racks) to provide inexpensive and corrosion-resistant earthquake and operational safety systems.

To reduce potential barrel damage, Vingenuity offers a Cradle Extender™ that attaches to rack-cradles providing additional height to prevent barrel roll-out, and a Rack Positioning System™ to align barrels and racks in a stack and minimize walking or sliding of racks. The two products were designed with winery personnel to minimize any negative impacts on winery operations. More than 30 wineries are using these safety devices. Marrow previously found that strapping or clamping barrels to a rack is effective, but not practical.

A new "Barrel Guard" system to improve barrel stability on racks was introduced by Western Square in 2005. It attaches to the rack and barrel chimes to center and hold a barrel in place on the rack.

For wineries that stack barrels in pyramids, a cradle system is available from Topco and Western Square. This avoids the use of traditional wooden chocks, which can slip out during an earthquake. However, Jeramaz at Grgich Hills Cellars finds cradles difficult to use when lining up barrels; he prefers traditional wooden chocks.

Rack manufacturers report they have neither designed nor tested for earthquake stability. Even though the Central Coast wineries of California have been hardest hit with earthquakes, many other regions of the U.S. and the world are also susceptible. Therefore, earthquake stability should be an important factor when considering barrel rack systems.

New or refurbished racks

As racks age, they must eventually be replaced. At least one company, Topco, can modify and refurbish the viable ones, providing cost savings to wineries. Topco has a system to abrade and strip the finish, check wall thickness (especially for internal rust) with ultrasound, inspect for other damage, and powder-coat the racks, giving them new life and appearance.

Reducing corrosion — powder-coated or stainless

High humidity in wine cellars takes its toll on all metal products, and racks are no exception. "The sight of peeling paint or the powder coat on the racks is really annoying," says Chris Phelps, winemaker at Swanson Vineyards (Oakville, CA), echoing the sentiments of many winemakers.

Throughout interviews for this article, no winemakers specifically mentioned a formal, in-house program to inspect barrel racks. However, all apparently examine their racks sporadically for damage and rust.

Wineries should establish an inspection program to monitor racks as they age. Inspection issues include accumulated damage to racks due to metal fatigue, external and internal rusting, and dings and dents caused by forklifts. Most rack producers date stamp their products, which should be helpful to this process.

In lieu of a formal inspection program, one rack producer suggests teaching forklift drivers and cellar workers to look for problems occuring in racks and to mark and/or set aside for further inspection any rack showing significant signs of wear.

Environmental factors causing wear include: humidity in the cellar, nearness to the ocean (salt water is corrosive), forklift driver skill, height of the stacks, and how many times each rack is moved.

Winemakers and rack producers indicate that the life expectancy of the protective powder coat finish on a conventional, tubular-steel rack is five to seven years. This may be extended by Topco's refurbishing process.

Given the weight stress, scraping on concrete and occasional dings by a forklift, the powder coating and paint of the racks is gradually destroyed. With any break in this protective barrier, rusting of the metal commences. Occasionally it can commence immediately if the angles, especially on V-shaped cradles, are too sharp to allow complete sealing by the powder coating, or if a hole is created in the steel tubing due to careless welding in fabrication.

While structural integrity does not seem to be compromised in the early years, appearance and cleanability are certainly issues as the rust progresses. For these

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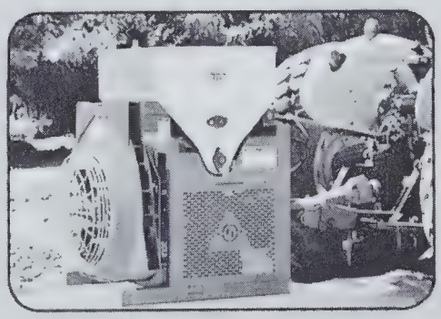

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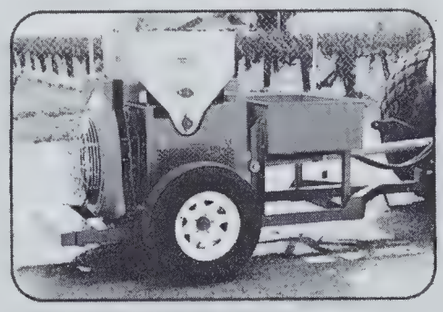

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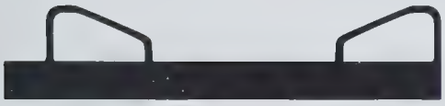

Topco Inc. saddle types: Topchock™ saddle. Eliminates powder coating difficulties found in other saddles, is stronger and lighter, and makes the rack more durable.

"Western" saddle, common on 4-barrel racks. Creates a somewhat springy stack; allows barrels to settle in place.

"Eastern" saddle; most common for 2-barrel racks, but used on many others.

reasons, manufacturers have created several alternatives.

The Barrel Master, RGB, and Sagarte are using galvanization as a method to minimize rust. Sagarte also coats racks in polyester. Whether these coatings will be an improvement on powder coating remains to be seen.

Using alternative materials to steel is how several companies have approached the rust problem. Stainless steel racks (Acufab, G.W. Kent, Topco, and Western Square), should offer years of quality appearance and life. Having used the G.W. Kent stainless (16 gauge steel) racks for two years, Karl Wente of Wente Vineyards (Livermore, CA) reports good results.

Cost

Cost of the racks is a critical issue, especially for wineries purchasing them in large volume. The recent increase in the price of steel (the raw material for most racks) has definitely impacted costs.

The cost of racks should be factored into your wine price. A question to consider is: Can you make better wine with a particular style of rack? As noted above, Ivo Jeramaz reports an improved taste in Grgich Hills Chardonnay as a result of the modular system for lees "stirring." Just as many coopers provide winemakers an opportunity to pick the right barrels for their wine style and price-point, the variety of rack designs allows many choices.

With so many choices, it is difficult to decide what system to use for a startup winery operation or when making changes at an existing winery. The following outline of alternatives is provided to help summarize the various choices. Also, visit the manufacturers' web sites and consult with company representatives to obtain current prices and exact specifications.

Conclusion

Forkliftable and modular barrel racks have offered unprecedented improvements in productivity, while still maintaining a high degree of quality associated with the use and handling of

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THREE STEP PROCESS

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3. Refurbishment. Racks passing inspection are powder coated. The finished racks look like new.

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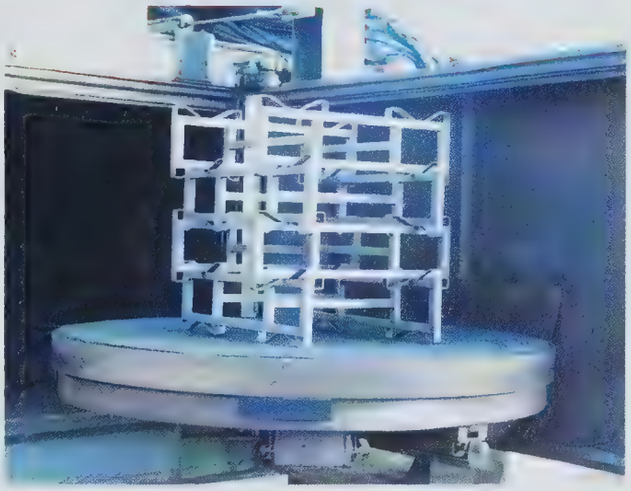

Background. When Topco Inc. began producing barrel racks for wineries in 1997, it was evident that these racks had a limited service life, primarily due to rust degradation. Although they were finished with high-quality powder coat, intrusions caused by denting or abrasion allowed metal exposure to the generally corrosive winery environment. Typically, after five to seven years of service, many racks are unfit for continued service. In addition, it was known that many wineries had extensive "boneyards" of damaged or obsolete racks which were rusting to perfection. Since then, Topco Inc. has searched for a solution. And now we are pleased to announce that one has been found.

Solution. The key to recycling wine barrel racks depended on finding an effective, convenient, inexpensive and environmentally friendly way to remove rust and old finish material. And now a solution has been found. Topco Inc. is proud to announce the installation of a Pangborn Rotoblast* surface preparation system, which works like a sandblaster, only better. With the Rotoblast* equipment, racks may be stripped to shiny bare metal in average of two minutes each or less. This machine is a self-contained factory. Inside a sealed cabinet, racks are stripped by two streams of high strength steel micro-balls, propelled by two large wheels that deliver 700 lbs./min. at about half the speed of a 45 caliber bullet. The racks rotate on a turntable in front of these streams to expose as much surface as possible. A material handling system recirculates the media from a trough in the bottom of the blast cabinet to a hopper above the slinger wheels. Finally, there is a sophisticated separation system that removes and captures all unwanted debris and dust. In all, this machine is about 22 ft. tall, 24 ft. wide, 15 ft. deep, and weighs about 61,000 lbs. not including the10,000 lbs. of media which it contains.

The Recycling Program. Although efficient stripping is the key to recycling wine barrel racks, an effective recycling program is important too. Topco Inc. offers four basic services: Refurbishment, Repair, Re-manufacturing and Removal.

1. Refurbishment. At customer's order, racks to be refurbished are collected and delivered to us at our expense. Racks are then stripped, inspected, and categorized. Those found to be in serviceable condition, minor dings allowed, will be refinished with new powder coat in customer's choice of color. Any racks that are not suitable for refurbishment become Topco Inc. property unless other arrangements are made. Return shipping costs are borne by the customer.

2. Repair. This service includes all the features and conditions of refurbishment, except that damaged racks will be repaired at a flat rate per rack to be determined on a case-by-case basis.

3. Remanufacturing. This service includes all the features of Refurbishment and Repair, except that racks will be modified at a flat rate per rack to be determined on a case-by-case basis. A common example of this type of service is the conversion of two crossbar racks to four crossbar racks.

4. Removal. Topco Inc. will be glad to remove and dispose of any unwanted racks at no cost to the customer.

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barrels. The many alternative designs, styles, and materials of racks offer winemakers an even greater range with which to tailor an individual wine production program. ■

SUMMARY OF RACK SYSTEMS

PORTABLE STEEL BARREL RACKS — TWO-BARREL RACKS

Advantages: Lower cost per rack than other systems, flexibility in floor plan and barrel movement, many sizes, colors, raw materials and models available.

Disadvantages: Cannot mix barrel styles, difficult to line up barrels and racks, dangerous to use on excessively sloped floors, lack of stability in earthquakes.

STAINLESS STEEL RACKS

Advantages: Longer life cycle, attractive.

Disadvantages: Higher initial cost.

PORTABLE STEEL BARREL RACKS — FOUR-BARREL RACKS

Advantages: Higher productivity per forklift load, greater stability than two-barrel models.

Disadvantages: Requires larger, more powerful forklift, requires greater number of total barrels for cost-effectiveness, more space needed, especially for turning aisles.

RACK-ON-RACK SYSTEMS

Advantages: Can mix barrel styles and, within reason, various sizes, ease of stacking, even for inexperienced forklift drivers, no weight on barrels.

Disadvantages: Difficult to get barrels in and out of some models, higher initial cost, some models may add to height of the stack.

MODULAR SYSTEMS

Advantages: All processes can be performed while barrels are in stacks, no forklift required, can mix barrel styles, may aid in actual winemaking.

Disadvantages: Requires a relatively sophisticated in-place cleaning system, semi-permanent, barrels must be hand-lifted in and out of modules, higher initial cost.

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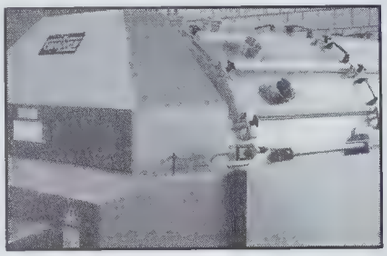

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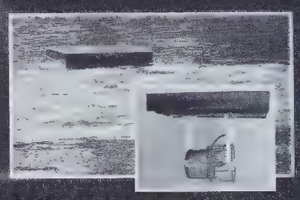

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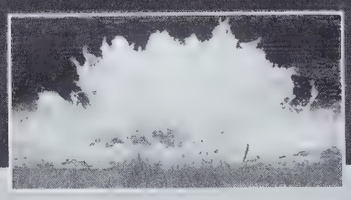

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Barrel-stack safety

Many of us who have worked in barrel cellars are guilty of climbing on barrels in the racks, despite the fact that falls are the second most frequent cause of fatal industrial accidents according to the Bureau of Labor Statistics (2004).

Some winemakers even shake the stacks to show how rigid they are. A six-high stack of two-barrel racks can weigh about 7,000 pounds, but one false, improper move could cause it all to come crashing down. While access to the bung hole has increased with seven-inch rack spacing, the whole purpose of the rack system was to easily unstack barrels for processing, rather than allowing for climbing on them.

Climbing and walking on barrels is dangerous, and climbing on barrel stacks — especially those five- and six-high — even more so. Climbing on the stacks to take samples, make SO_2 addition, rack, top, or perform any other process is an accident waiting to happen. Regardless of how high the stack or how "sturdy" it seems, *don't allow anyone to climb in or on the stacks.* Either forklift the barrels out of a stack for processing or provide aisle space for ladders to access barrels.

Forklifts

It is easy to blame forklifts for the many misdeeds they inflict upon racks and barrels, but more often the culprit is human error — lack of training, fatigue, and/or speed. According to Trygve Mikkelsen, president of Western Square Industries (Stockton, CA), damage to racks caused by being hit, snagged, or dropped from forklifts is about the same as from rusting.

Forks need to slide in easily under the rack without hitting it. This is a function of the width of the opening and the skill of the driver. Uneven forks, sloppy forklift controls, and sloped cellar floors all add to the difficulties of trying to locate a small opening 12 to 15 feet above ground.

Enlarging the height of the fork opening on the racks from three inches to seven inches, according to Mikkelsen, has decreased the incidence of punctured side rails on the racks. Thor Ourston (Topco Inc.) reports more than 10% damage to racks with a three-inch opening and less than 1% damage to racks with a seven-inch opening based on analysis of racks received for refurbishment.

If the forks slide into the rack easily, they can also slide out easily — an all-too-frequent occurrence when the forklift stops suddenly, cascading the barrels and racks off the forks. This usually results in damaged racks, broken chimes or heads on the barrels, and most important, lost wine.

Western Square has introduced a new Tuff-Coast coating for its racks, which has a rubbery and dimpled surface that helps to minimize sliding of barrels and racks, Mikkelsen notes.

Another problem occurs when fork extensions are used. If the forklift driver is not careful, the longer forks can catch adjacent racks, tipping entire stacks over. One rack supplier is aware of several serious cellar accidents due to just this mistake.

Drivers must also make sure the forklift is sized properly for the number of barrels in any one load, and the height to which they are attempting to lift them. Using an undersized lift, puts both the driver and the cellar crew in danger.

"Forklifts should have steel overhead guards strong enough to protect the driver from falling barrels," notes Josh Marrow (Vingenuity). This could occur if someone is caught in the stacks during an earthquake, or when a driver hits a stack and knocks a barrel loose.

For example, an employee was operating a forklift in a winery near Paso Robles, CA, when the December 2003 California earthquake struck that region. The overhead guard protected this employee, who was treated for only minor injuries (www.vingenuity.net).

Both Federal OSHA and California OSHA regulations require overhead guard protection for forklifts, and driver restraints. (OSHA Regulations: Powered Industrial Trucks, Number 1910.178(e)(1) and California General Industry Safety Orders 3655 and 3653.) Lighting on the forklift is also recommended for dimly lit cellars and caves.

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COVER STORY

Collard Raptors blow leaves off one side of two vine rows simultaneously.

Mechanized leaf removal shows good results

BY Tina Vierra

Growers increasingly recognize that grapes with greater sun exposure develop more aroma and color and are less susceptible to powdery mildew and botrytis. As a result, leaf removal has become a critically important tool to optimize grape quality, and growers' enhanced interest has brought substantial technical development in leaf removal equipment.

Leaf removers operate either by blowing compressed air with enough force to sever the leaves or by sucking the leaves into the path of a cutting tool. In Europe, leaf removers from Collard, Galvit, and Siegwald (France) and Olmi (Italy) and others defoliate with compressed air. The device is connected to a rotary power transmitter on the tractor and is available for one-side, bilateral, or over-the-vine-row operation. A large compressor delivers compressed air via flexible hoses to leaf-removing head-pieces, which look like drums and are positioned vertically next to the fruit zone.

Inside the drum, air is expressed in high-velocity streams through rotary nozzles (outward curved air tubes). The nozzles rotate under a cover plate pierced with narrow semicircular slots, which direct the air toward the leaves that are to be removed. Work height can be adjusted by rotating the slots.

The slots interrupt the airflow at short intervals, so that leaves met by the air jet are not simply pressed to one side. The resulting strong pulsations of air ideally tear a whole leaf off, however, to a large extent, sections of leaf blades remain.

Compressed-air leaf removers are most suitable for early leaf removal, between bloom and pea-size berry development. Some individual berries will also be torn away, resulting in looser grape clusters and reduced potential of bunch rot. During this period, there is little danger that remaining berries will be damaged. A further advantage is cleaning of the grape clusters, because the strong airflow removes debris. However, in order to obtain the desired results, the airflow must be accurately adjusted.

Leaf removers at Robert Mondavi Vineyards

Monterey Pacific Vineyard Company is operating Collard Raptor leaf removers on approximately 1,800 acres near King City, CA, for Robert Mondavi Vineyards. Mondavi bought the initial Collard Raptor leaf remover in 2003, and it proved so successful that two more were purchased in 2004. At the same time, Monterey Pacific purchased its own Raptor leaf remover for use in other clients' vineyards.

"We save roughly $100 per acre using the Raptor leaf remover instead of hand labor," reports vineyard manager Ben Eisner at Monterey Pacific. "It costs about $25/acre to run the machines, versus $130/acre for hand leaf-pulling."

The Raptor mounts onto the company's Braud over-the-row harvesters and works one side of two vine rows at a time. Leaf removal is done on the side of the canopy receiving morning sun, to expose clusters to the air and sunlight and allow better pesticide application. Leaves remain on the other side of the canopy to protect clusters from afternoon sun and its attendant risk of sunburn.

Spacing in Mondavi King City-area vineyards is 8x5 or 8x6. The Braud over-the-row chassis with two Collard leaf removers travels at a speed of 1½ to 2½ miles per hour,

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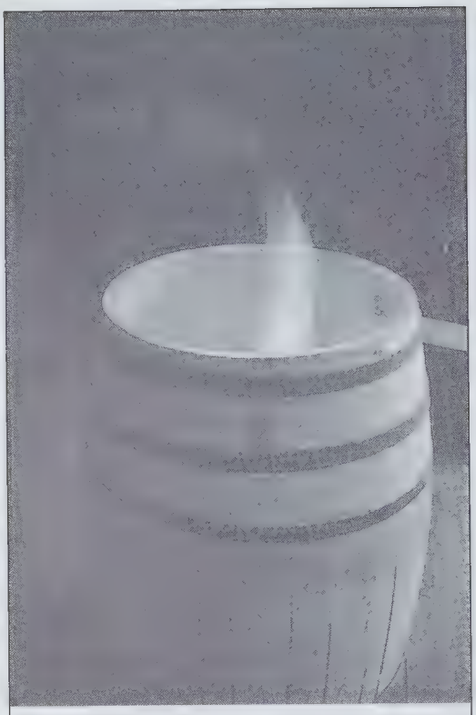

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covering an average of three acres per hour, depending on terrain and foliage. The distance between leaf remover and vine row is regulated with a guide rail.

The operator can make simple adjustments to take more or fewer leaves as needed and reduce air pressure if too many leaves are coming off or berries are endangered. One pass is usually sufficient to remove the desired amount of leaves. Eisner or another Monterey Pacific vineyard manager then walks the field to assess and, very occasionally, might determine to take another pass or deleaf the other side of a row.

Leaf removal procedures at Mondavi Central Coast vineyards were determined by conferences between Mondavi vineyardists, winemakers, and Monterey Pacific vineyard managers. Leaf removal usually begins in May with Pinot Noir (at Mondavi's 750-acre Bianchi Ranch in Gonzales, Monterey County, CA). Leaf removal on Chardonnay, Merlot, Syrah, and Cabernet Sauvignon occurs through June and into July as needed in King City.

Introduction of mechanized leaf removal into the vineyard management program worked well, and both Monterey Pacific and Mondavi are pleased with the cost-effectiveness of the Collard machines. Eisner no longer needs to hire, supervise, or adjust work crews constantly for hand leaf removal, and he can leave a single operator with each machine once it is mounted. The machines run day and night shifts during the leaf removal season.

"The Raptors are bullet-proof," says Eisner. "They're simple to operate and troubleshoot, and only take about half a day to mount. They have plenty of power and adjustable hydraulic pressure for terraced and hillside vineyards."

The single downside to the mechanical leaf removal, notes Eisner, is that it often needs to be done concurrently with spraying for potential mildew; unfortunately, the sprayers mount onto the same Braud harvesters as the Raptor leaf removers. Eisner finds himself juggling machine time between spraying and leaf removal, but overall, he is too happy with the benefits of mechanized leaf removal to fuss about this new challenge.

Positive effects of leaf removal

Erika Winter, co-author of *Winegrape Berry Sensory Assessment in Australia* (see ***PWV*** Bookshelf), explains that better sunlight exposure of the grapes and clusters leads to a warming of the berries. This enhances the reduction of malic acid.

"These temperatures occur most often and are most prolonged in the grape clusters in direct sunlight," Winter explains. "With higher temperatures, a slightly increased water evaporation occurs, which causes an additional concentration of the berry contents."

Good exposure of the grapes also promotes production of phenolic substances in the berry skins. These include the red color materials, or anthocyanins and tannins, and play a particular role in wine character and color development of red varietals. A berry's aroma development is positively influenced by good sun exposure of the grapes.

The main advantage of leaf removal is improved ventilation and exposure leading to faster drying of clusters, which reduces mildew and botrytis, Eisner reports. With less risk of rot, it may be possible to postpone the harvest date, which may have a positive effect on grape maturity.

Timing of leaf removal is more crucial than technique

Oswald Rage, a regional vineyard expert in the Rural Office for Rheinhessen, Nahe, and Hunsrueck, Germany, and his German colleagues studied the impact of leaf removal at different points in berry development. First, they tried leaf removal between berries at pea size and berry softening. These trials showed, however, that late leaf removal can be

unfavorable. In particular, serious sunburn damage proved an increasingly large problem.

The Germans found that early leaf removal — between beginning of flowering and pea-size berries — has clear advantages compared to a later date. Early exposure of berries leads to a stronger layer of wax and a thicker berry skin, which increase the resistance to sunburn and botrytis.

A further previously unconsidered effect of leaf removal is improved deposit of plant protection agents. As Eisner notes in his work on the Mondavi King City vineyards, the amount of pesticide spray landing on the grapes is clearly increased by first performing leaf removal in the cluster zone.

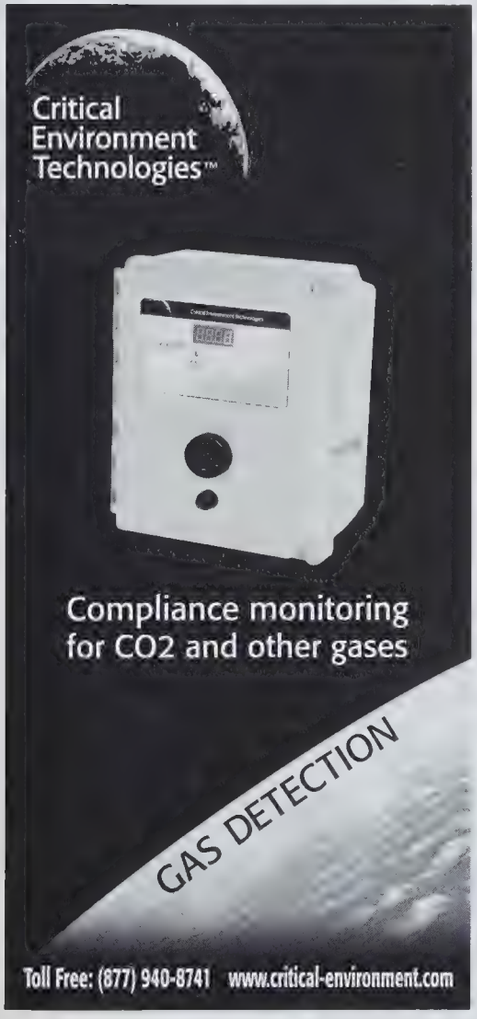
The Germans discovered that, when defoliating only in each second vine row, the spray values in the alternate (non-leaf removal) rows were somewhat higher than when spraying every vine row without performing leaf removal. They determined that with a leaf-pulled cluster zone, they could reduce spraying to every other vine row if they wished, and/or reduce the amount of pesticide used.

Fruit thinning with leaf removers

The Germans also tested the possibility of yield reduction by leaf removers and decided that the idea offers some advantages. For the purpose of thinning fruit, they found that compressed air devices (such as the Collard leaf removers at Mondavi) were at a disadvantage compared to suction devices used in Europe, which are fitted with protective bars to prevent grapes from being sucked in. With adjustments to the distance between the bars on a suction deleafer, they found they could thin berry clusters while removing leaves.

However, they concluded that fruit thinning with a leaf remover at the optimum time for leaf removal did not achieve the same berry quality as manual fruit thinning at the beginning of veraison would have done, and won't be feasible without further study.

Like the Germans, Eisner isn't ready to combine fruit thinning and leaf removal. "We prefer to drop crop at veraison, so we can determine uniformity better," adds Eisner. "Combining the two sounds a little scary to me, but if it were possible, you could save another $50 to $100 per acre." ■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Improving grapevine productivity—mitigating Armillaria root disease

BY Dr. Kendra Baumgartner,
Amy E. Warnock,
USDA-ARS, Davis, CA

Armillaria root disease occurs in all major grapegrowing regions of California. *Armillaria mellea*, the causal fungus, infects woody grapevine roots and decomposes the underlying vascular tissue. Armillaria root disease affects vineyards planted on sites that were previously occupied by infected forest trees or orchard trees.

Despite its common name of "oak root fungus," *A. mellea* has a broad host range, infecting over 500 species of woody plants.[5] Native hosts of *A. mellea* include oaks and other common forest trees such as Douglas-fir, California bay laurel, and madrone.[2] *Armillaria mellea* also infects many planted hosts in California, including orchard trees (such as walnut) and woody landscape plants (such as rose).

Attempts at eradication

Some of the most toxic fungicides are only partially effective at delaying infection of grapevines by *A. mellea*. Pre-plant soil fumigation with methyl bromide either kills *A. mellea* mycelium in buried tree roots or weakens it, which predisposes the pathogen to attack by antagonistic soilborne fungi.[4] However, soil fumigants typically do not reach all infected tree roots.

Efforts to eradicate *A. mellea* from infected grapevines through fungicide/biocide application to the surrounding soil are unlikely to affect the fungus, since it grows beneath root bark.

Cluster of *Armillaria mellea* mushrooms on the root collar of an infected grapevine.

Cultural control

Results of previous studies demonstrated the potential of a cultural approach called "root collar excavation" for control of Armillaria root disease of grapevines.[1] The technique involves permanent removal of soil from the base of the vine's trunk, to the depth at which main roots originate (the root collar), in an effort to protect this important part of the root system from vascular tissue decay. Root collar excavation improves yields and growth of infected grapevines, when applied before the fungus reaches the root collar and girdles the vine.

Research on root collar excavation demonstrated that grapevines can tolerate root disease and remain productive if the disease is slowed down early in the infection process. Focusing control efforts on infected grapevines that still produce normal clusters is a cost-effective strategy, given that replants are not immediately productive and are, unfortunately, likely to become infected by *A. mellea*.[3]

Biological control

The goal of the research reported here was to evaluate the efficacy of VESTA® (Biologically Integrated Organics, Inc., Sonoma, CA) to improve yield and growth of vines with Armillaria root disease.

It was previously shown that vines with Armillaria root disease have significantly fewer clusters, lower yields, and smaller clusters.[1] In terms of growth, symptomatic vines also have fewer shoots, lower pruning weights, and smaller shoots.[1] Therefore, amelioration of these impacts can be used as measures of the efficacy of VESTA.

Laboratory assays

VESTA is registered as an organic soil inoculant with the California Department of Food & Agriculture. Laboratory assays show that VESTA inhibits *A. mellea* growth in culture (BBC Laboratories, Tempe, AZ). Viable bacteria isolated from VESTA — *Bacillus* and *Pseudomonas* species which

were found to inhibit *A. mellea* growth in culture — may function as antagonists of *A. mellea* in the field and/or as grapevine growth promoters.

VESTA results from a proprietary fermentation process of several composts that vary in age and raw materials. The product of this fermentation process is passed through a 100-micron filter in order to allow application of the soil inoculant to crops via drip irrigation systems. VESTA is extremely low in plant-available nutrients (0.001% N, 0.001% phosphoric acid, 0.001% soluble potash), but is thought to consist of complex C compounds that may help sustain the microorganisms in VESTA.

Field experiment

An experiment was designed that utilized VESTA as a therapeutic treatment (a product applied to a diseased plant in an attempt to prolong its life). The success of a therapeutic treatment depends on how much vascular tissue in the root system has already been destroyed, in addition to the ability of the treatment to decrease further colonization of healthy tissue. Based on past research on root collar excavation, we anticipated that timing applications early in the infection process might be critical to the success with the soil inoculant.

Observations were focused on vines that showed moderate symptoms of Armillaria root disease (stunted shoots approximately half the length of those of healthy vines, with some chlorotic leaves). Based on past research, the appearance of moderate symptoms signifies that the vine's root collar is infected by a mycelial fan of *A. mellea*.[3]

In years following the appearance of a mycelial fan at the root collar, symptoms become more severe (shorter shoots with more chlorotic leaves, premature defoliation, and berry dessication) as the fungus eats through the underlying cambium and woody root tissue, thereby girdling the base of the trunk. Moderately symptomatic vines are more likely to benefit from a therapeutic treatment than severely symptomatic vines because they still have some capacity for root growth.

Vineyard sites

Research was conducted in two California North Coast vineyards, both with Armillaria root disease, but with different mortality rates. A Napa vineyard was planted in 1997 with dormant bench-grafts of Cabernet Sauvignon (Clone 337) on 110-R rootstock with 6 x 8 foot spacing. A Sonoma vineyard was planted in 1991 with dormant rootings of 3309C and field-grafted in 1992 with Pinot Noir, spaced meter x meter.

Armillaria root disease was diagnosed in the Napa vineyard in 2001. The Sonoma vineyard has a longer history of Armillaria root disease, with the first symptomatic vines having been identified in 1996. Before the start of this study, in 2001 and 2002, the disease severity was calculated by mapping the change in status of every vine in each vineyard.

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In the Sonoma vineyard, 10% of the vines died from Armillaria root disease. In the Napa vineyard, the mortality rate was only 2%.

Treatment strategy

Experimental treatments were replicated in each vineyard over two years. Each vineyard was divided into sections and, within each section, half of the rows were treated with VESTA (treated rows) and the other half with water (non-treated rows) in 2003 and 2004. There were three replicated sections in the Napa vineyard and two replicated sections in the Sonoma vineyard. Within treated and non-treated rows, 10 healthy and 10 symptomatic grapevines were randomly chosen for data collection, to give a total of four experimental treatments:

- healthy non-treated,
- healthy treated,
- symptomatic non-treated,
- symptomatic treated.

Symptomatic grapevines were characterized by having shoots approximately 50% the length of those of healthy grapevines. All symptomatic grapevines were diagnosed with Armillaria root disease by examination of their root collars for mycelial fans of *A. mellea*.

To avoid sampling symptomless grapevines that were infected on deeper parts of their root systems, grapevines immediately adjacent to a dead grapevine or a severely symptomatic grapevine were excluded. No mycelial fans were found at the root collars of healthy grapevines selected for data collection.

The soil inoculant was injected into the irrigation system of treated rows at the following phenological times and rates:

- budbreak (5 gal/acre),
- full bloom (5 gal/acre),
- 15% veraison (2 gal/acre),
- 85% veraison (2 gal/acre).

Petiole samples and soil samples were collected at full bloom in 2003 and 2004. Soil samples were collected using a hand auger to a depth of 15 cm. Samples were submitted to DANR Analytical Laboratories, Davis, CA, for nutrient composition analyses (for soil: total C, total N, NO_3-N, P, K, Zn, pH, CEC; for petioles: total N, P, K, B, Zn).

In 2003 and 2004, on the day of harvest, clusters were counted, harvested, and weighed. During the dormant seasons, prunings from the same grapevines from which yields were collected were weighed. An analysis of variance (ANOVA) was used to determine the effects of vine status (healthy or symptomatic), VESTA (treated or nontreated), year (2003 or 2004), and their interactions on grapevine yield and growth parameters, and petiole and soil nutrients.

Results

Based on analyses of yield and growth parameters, VESTA had positive effects on yield and cluster weights of symptomatic

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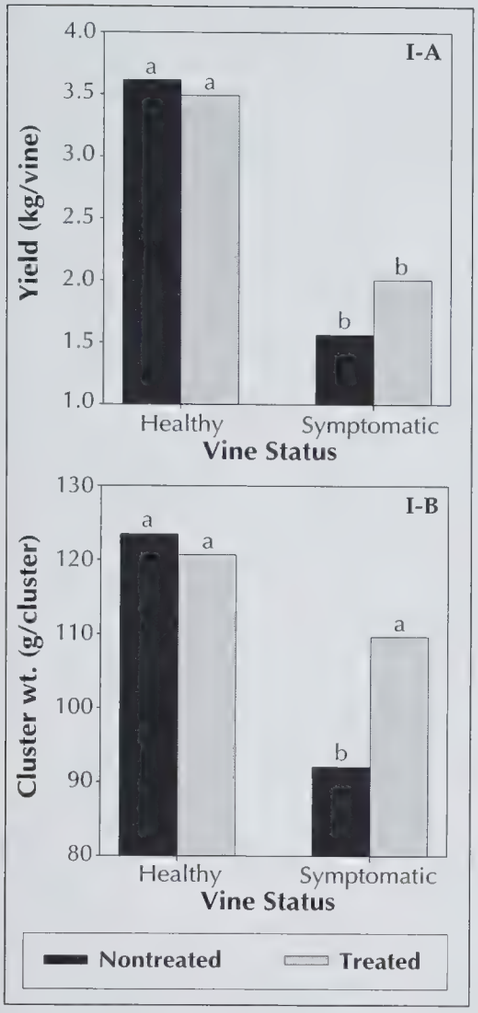

Figure I. Effects of VESTA on yields and cluster weights of healthy and symptomatic grapevines in the Napa vineyard. Each column represents the mean of 60 observations, averaged across 2003 and 2004. Columns with different letters are statistically different. While healthy grapevines had significantly more clusters than symptomatic grapevines, there was no effect of VESTA on cluster number for either category (data not shown).

grapevines in the Napa vineyard. Symptomatic treated grapevines had higher yields than symptomatic nontreated grapevines, but these differences were not statistically significant. (Figure I-A).

However, the yield increase observed with VESTA treatment of symptomatic grapevines from 1.56 kg/vine to 2.01 kg/vine, a 22% increase, would likely be considered economically significant, with material costs offset by increased yields.

Symptomatic treated grapevines had higher cluster weights than symptomatic non-treated grapevines, and these differences were statistically significant (Figure I-B). In fact, cluster weights of symptomatic treated grapevines were, statistically, as high as that of healthy grapevines.

In the Napa vineyard, pruning weight increases were not statistically significant (Figure II), but the same relative differences among treatment groups in both study years were observed.

In the Napa vineyard, treated grapevines had significantly higher soil C than non-treated vines (34.45 mg/g dry wt. versus 28.80 mg/g dry wt.). Effects of VESTA on the other soil nutrition parameters (total N, NO_3–N, P, K, Zn, pH, CEC) were not significant, nor were effects on petiole nutrients (total N, P, K, B, Zn).

There were no significant effects of the soil inoculant on yield, growth, or nutrition parameters in the Sonoma vineyard. It is possible that symptomatic grapevines in this vineyard are more heavily infected with *A. mellea* than those of the Napa vineyard, given the longer history of Armillaria root disease. A higher application rate of VESTA may be required for vineyards that have suffered losses for more than five years.

It is also possible that the low yields on all vines in the Sonoma vineyard made it difficult to detect statistically significant changes. Given the extremely low yields among even the healthy grapevines (mean yield for both study years, 0.94 kg/vine), it is difficult to recognize significant yield increases, especially among the symptomatic vines (0.68 kg/vine).

The mechanism by which VESTA affects Armillaria root disease is not known. Bacteria present in VESTA may directly parasitize *A. mellea* mycelium and/or secrete fungistatic compounds. Increased soil C among treated grapevines suggests that higher microbial populations were encouraged by VESTA, but it is not known whether these microbes were the same species that have been identified from VESTA.

It is important to remember that the symptomatic grapevines in this study

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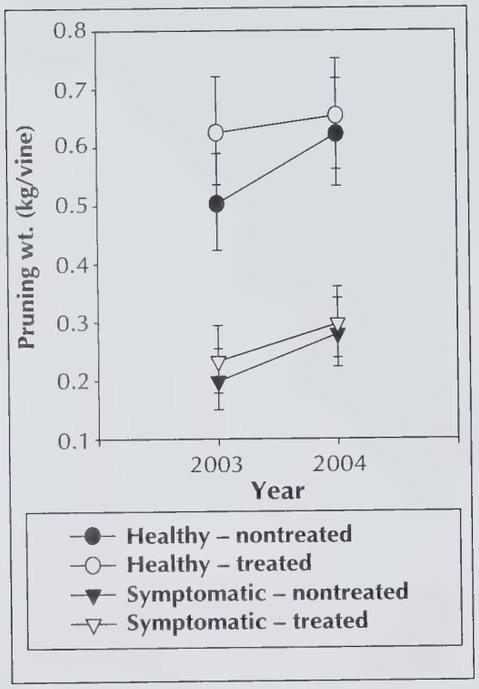
Figure II. Effects of treatment with VESTA on pruning weights of healthy and symptomatic grapevines in the Napa vineyard. Each point represents the mean of 30 observations. Error bars represent 95% confidence limits. Points with non-overlapping error bars are statistically different.



have undergone substantial root system destruction over the course of several years prior to VESTA applications. Their capacity has been steadily deteriorating since they were first infected by *A. mellea.*

Conclusions

In summary, VESTA had no effect on yields of healthy vines, but it did help symptomatic vines in the Napa vineyard with less Armillaria root disease. It increased yields (economically speaking) and cluster weights (statistically speaking) of symptomatic vines.

VESTA appears to be a promising approach for control of Armillaria root disease, as long as vineyards are treated soon after the disease is diagnosed. It is unrealistic to expect VESTA or any therapeutic treatment to fully restore yield and growth to infected vines in only two growing seasons.

Therapeutic treatments are more likely to be successful when used early in the infection process, once symptoms appear in the vineyard. ■

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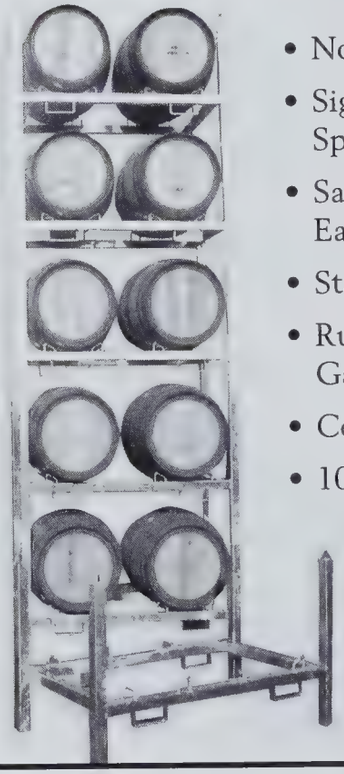

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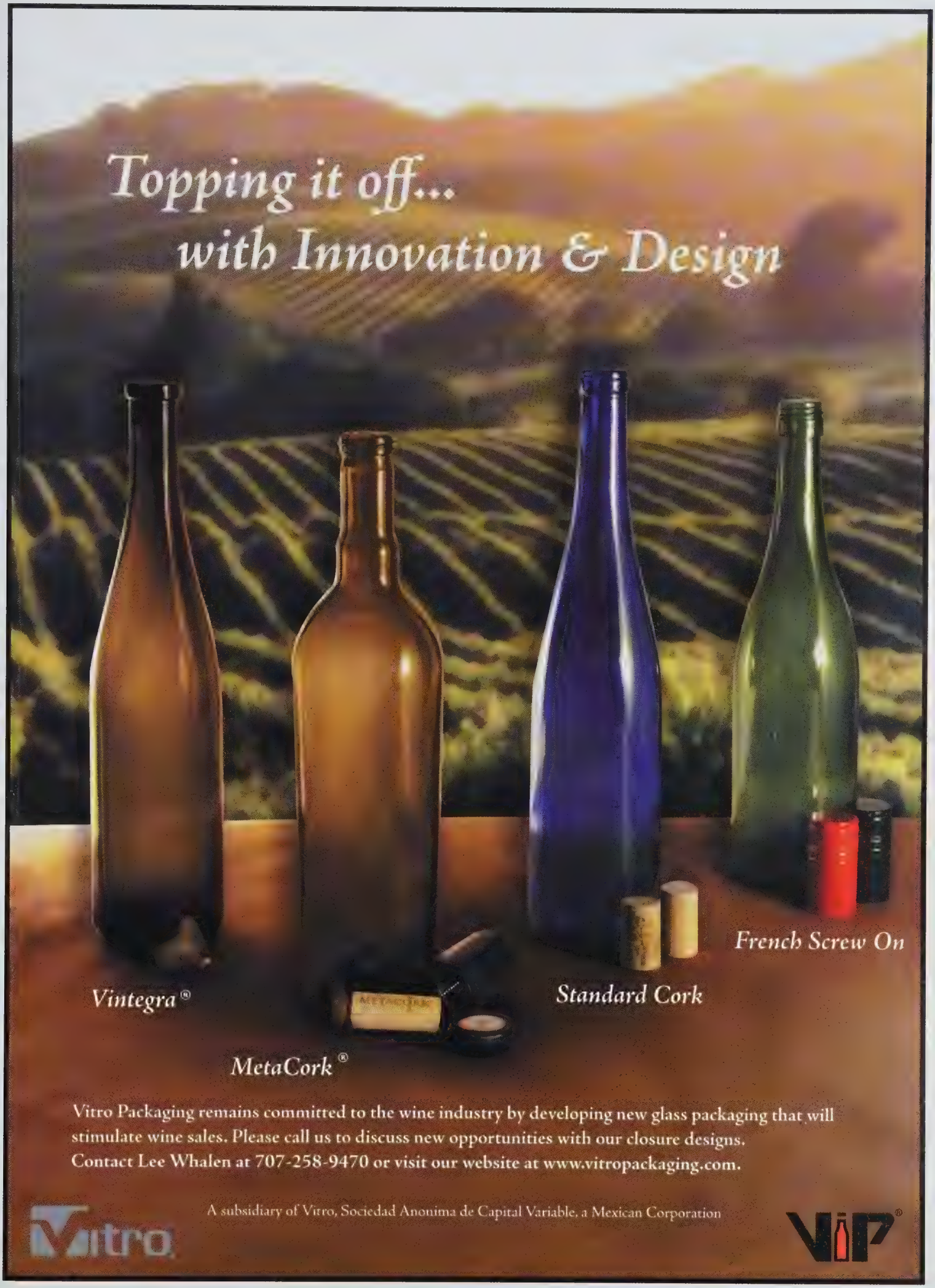
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WATER AND WINE

Regulation of vineyard and winery development and operation in California's North Coast counties

BY Christopher J. Carr and
Janelle E. Kellman
Stoel Rives
San Francisco, CA

Over the last decade, as a boom in vineyard and winery development has swept California's North Coast counties from Napa to Sonoma and, more recently, Mendocino, environmental regulation of vineyard and winery development and operation has become increasingly stringent. These regulatory efforts have focused predominantly on water quality.

While vineyard managers and winemakers confront a broad range of environmental issues — from endangered species impacts to pesticide use — water quality issues dominate the agenda. This article provides a broad overview of those issues in the region.

A number of government "players" administer the complex quilt of local, state, and federal water quality laws and regulations. County planning agencies address water quality concerns in permitting the development of vineyards and wineries. The California Department of Fish and Game and U.S. Army Corps of Engineers may have a permitting role for work done in streams or other water bodies.

Where water pollution affects salmon or trout, the federal NOAA Fisheries (formerly National Marine Fisheries Service) may also become involved. The North Coast Regional Water Quality Control Board ("Regional Board"), which has only a minor role in permitting of vineyard and winery development, has the lead role in enforcing water quality laws and regulations governing vineyard and winery development and operation.

Two different pitfalls to be avoided in hillside vineyard construction. In foreground, gully erosion on a recently graded road has resulted from improper compaction and inadequate erosion control and drainage. In background, deep and unstable fill covers a stream at the point where a drainpipe exits the fill.

In some cases, district attorneys, often upon referral from Department of Fish and Game wardens, may enforce the state's strict liability pollution laws under the Fish and Game Code and Water Code. Finally, apart from these government agencies, "citizen groups" may bring so-called "citizen suits" to challenge vineyard and winery development and enforce water quality laws and regulations.

Vineyard development/operation Local regulations

The planning departments of the North Coast counties have focused most of their vineyard-related regulation on grading and vineyard plantings on hillsides through "hillside ordinances."

Napa County adopted the first hillside ordinance among North Coast counties in 1991, imposing a range of hillside erosion controls that restrict hillside plantings. The ordinance prohibits vineyard plantings on slopes greater than 50%, and it requires a county-approved erosion control plan and a permit from the county for plantings on slopes of 5% or greater.

Napa's ordinance was amended in 1994 to allow vineyard owners who want to replant existing vineyards on relatively simple or non-erosive sites to file a vineyard replant program, rather than a full erosion control plan.

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The 1994 amendment also provides for stream setbacks and slope limitations for new developments and clarifies that vineyard replants are exempt from setback restrictions under certain conditions. The planning division of the Napa County Conservation, Development and Planning Department administers the hillside ordinance.

In March 2004, Napa County voters rejected an initiative that would have made the stream setback requirements of the hillside ordinance more restrictive. Although the hillside ordinance is widely regarded as having led the way for county efforts to address erosion from vineyards, in 1999, the Sierra Club sued the County of Napa on the grounds that the ordinance skirted the requirements of the California Environmental Quality Act (CEQA). The county eventually resolved the lawsuit by agreeing to mandate stricter compliance with CEQA, subjecting applications for hillside development to yet greater environmental scrutiny.

Following Napa's example, in February 2000 the Sonoma County Board of Supervisors adopted the Sonoma County Vineyard Erosion and Sediment Control Ordinance to specifically address the effects of vineyard planting on water quality.

There are four key elements of the Sonoma ordinance:

First, as in Napa, the ordinance prohibits the planting of vineyards on slopes greater than 50%.

Second, it requires erosion control plans for plantings on slopes greater than 10% to reduce the potential of sedimentation from vineyards to surface waters.

Third, all new vineyard planting must be reviewed by and receive approval from the county agricultural commissioner.

Fourth, it incorporates stream setback requirements for new vineyards. It provides for three levels of riparian setback requirements from streams, in some instances requiring vineyards to be planted as far as 50 feet back.

While Napa County's approval of erosion control plans is now subject to CEQA review, Sonoma County has attempted to obviate the need for such review by including language in its ordinance to suggest that decisions made pursuant to it are ministerial, rather than discretionary, and, therefore, do not trigger CEQA review.

Unlike Napa and Sonoma counties, Mendocino County does not yet have a hillside ordinance. Instead, it has developed a draft grading ordinance that regulates agricultural activities in general, including vineyards. The draft ordinance is the product of a "Grading Ordinance Committee" created by the Department of Planning and Building Services at the direction of the Board of Supervisors in January 2001.

The proposed Mendocino ordinance focuses on erosion control, sug-

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gesting methods for protection of watercourses/riparian areas and for assessing what size and type of projects should be subject to CEQA. It also delineates grading permit requirements. Following some dispute, a requirement for erosion control plans to be developed by qualified professionals was included in the ordinance.

Left unresolved by the draft ordinance was the extent to which activities in riparian areas should be limited, and what sort of riparian areas should qualify for protection. There is additional controversy about the trigger level for application of CEQA review.

The current draft also authorizes the permitting agency and county law enforcement to address violations through stop work orders, and administrative, civil or criminal penalties. In March 2005, the Mendocino County Board of Supervisors will consider what should be done, including whether the grading ordinance is necessary in light of existing federal and state regulations.

State and federal regulations

The water quality aspects of vineyard development and operation are subject to regulation under the federal Clean Water Act, the California Water Code, and the California Fish and Game Code.

Activities involving work in streams or other water bodies will usually require a Streambed Alteration Agreement from the Department of Fish and Game; they may also require a Clean Water Act section 404 permit from the U.S. Army Corps of Engineers, authorizing placement of fill material.

Section 404 permits must receive "certification" from the Regional Board under section 401 of the Clean Water Act, ensuring that the authorized activity will comply with water quality standards.

The Regional Board also reviews and comments on CEQA compliance documents, and on permits issued by the California Department of Forestry and Fire Protection authorizing conversion of timberlands to vineyards.

Although vineyard grading, terracing, and planting (as agricultural activities), do not trigger the need for a stormwater discharge permit pursuant to section 402 of the Clean Water Act, the Regional Board takes the position that construction of buildings and reservoirs for vineyards does.

While the Regional Board's role in reviewing and permitting vineyard development is limited, it plays a significant role in regulating the water quality aspects of vineyard development and operation by its enforcement of the Water Code and the North Coast Basin Plan's prohibition on the discharge of soil, silt, or other earthen material that could be deleterious to fish, wildlife, or other beneficial uses of water.

The Regional Board may act on a tip provided by a concerned neighbor or downstream owner who observes turbid water that they believe results from upstream vineyard development. If such sedimentation is occurring, the Regional Board can respond by issuing an order directing compliance with the Water Code and Basin Plan.

Such an enforcement order may require preparation and submittal of various "technical reports," including erosion control plans, plans for removal of any discharged sediment that remains in streams, and a landslide investigation report. The Regional Board may issue a follow-up order indicating deficiencies if the landowner's response is inadequate, or if sedimentation continues.

If further enforcement is needed, the Regional Board's next step can be to issue a cleanup and abatement order (CAO). A CAO may incorporate the unmet requirements of any earlier orders, direct the landowner to inventory the areas where erosion occurred and estimate the volume of sediment delivered to streams, and remove sediment from streams where feasible.

Failure to comply with these Regional Board orders can result in the imposition of fines through the administrative civil liability (ACL) process, formally initiated by the issuance of an ACL complaint.

Failure to submit timely reports can result in fines of $1,000 for each day a report is late. Fines for sediment discharges may be assessed up to $5,000 per day, or $2,000 per cubic yard ($10 per gallon). In certain cases, the Regional Board may order that some or all of a civil liability assessment be suspended and satisfied through completion of work necessary to achieve compliance.

Regional Board orders to enforce the Basin Plan's discharge prohibition must be administratively appealed to the State Water Resources Control Board ("State Board") before they can be challenged in court. The recipient of an ACL complaint is entitled to a public hearing before the Regional Board, and may appeal an ACL order to the State Board.

The Regional Board may also "refer" violations to the attorney general for enforcement action in superior court, including civil penalties and injunctive relief. This has been done where coordination is needed among multiple agencies.

District attorneys have authority under Fish and Game Code section 5650(a) and Water Code section 13387(a) to prosecute cases involving erosion from vineyard development. Both sections 5650 and 13387 are "strict liability" pollution laws; they do not require proof that the defendant intended to violate the law.

In such cases, the district attorney may act on behalf of the Department of Fish and Game, but will, in any event, usually consult and collaborate with the Regional Board and NOAA Fisheries (where a pollution event may have impacted salmon or trout protected by the federal Endangered Species Act).

Though resolution of pollution cases brought by district attorneys varies, in most instances remedial work — essentially nuisance abatement — and some sort of penalty or restitution payment are components of any settlement.

A district attorney's settlement of a case may encompass any claims that other agencies had or could have made against the defendant under principles of *res judicata* and, therefore, provide "global" resolution and finality with respect to all of the various agencies involved.

Winery development and operation

County planning departments may seek to address water quality to some extent in permitting construction of wineries, but the Regional Board has much greater responsibility for water quality regulation of winery development and operation in its administration of the federal Clean Water Act and the California Water Code.

General winery permit

The Regional Board issues a waste discharge requirement (WDR) to regulate discharge to land of pollutants that could potentially impact water quality. The Regional Board has, in the past, issued an individual WDR for winery wastewater treatment and disposal systems. It also previously issued waivers of a WDR if the wastes at issue were expected to have little or no impact on water quality.

However, as of January 1, 2003, the Regional Board will issue an individual WDR only in exceptional circumstances. Rather, it has created the General Waste Discharge Requirements for Winery Wastewater Systems (Order No. R1-2002-0012; "General Winery Permit") to cover the discharge of wastes produced as a byproduct of wine production. This permit is not intended to cover wastes produced by wine-related agricultural activities.

The General Winery Permit will preclude wineries from holding individual waivers of a WDR. Since a waiver of a WDR is generally good for five years, wineries holding recently issued waivers do not have to take immediate action under a General Winery Permit.

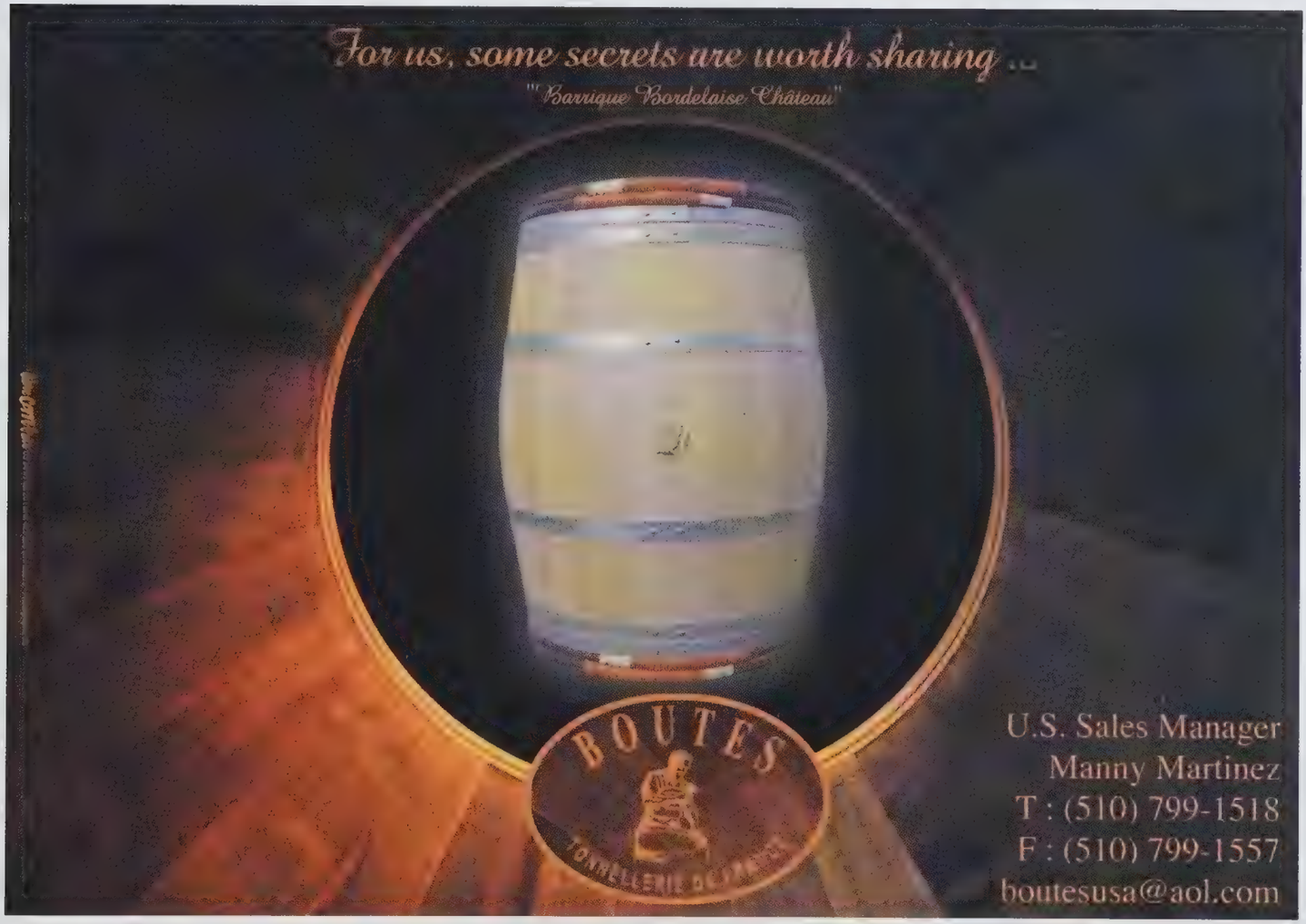
In contrast, wineries whose waivers have expired must now apply for coverage under the General Winery Permit. After June 2003, the only wineries eligible for waivers are non-commercial operations or operations producing less than 200 gallons of wine annually. Such small-scale wineries are not subject to the General Winery Permit.

The General Winery Permit covers wineries with subsurface disposal systems such as septic tanks and leach fields, but does not cover wineries that combine process and domestic wastewater into ponds. Although the General Winery Permit is intended to apply to all wineries, if a winery has unique characteristics that render it ineligible for coverage, the Regional Board will design an individual WDR to accommodate that facility.

Requirements of the General Winery Permit are relatively straightforward, imposing effluent limitations, requiring protection of groundwater, and directing management and disposal of solid waste. The General Winery Permit also imposes monitoring and reporting requirements, and mandates that facilities submit reports detailing compliance or noncompliance.

Application for coverage must be made by filing a Notice of Intent with the Regional Board. Although the Regional Board adopted a negative declaration under CEQA for new discharges of waste, the issuance of a general WDR is a discretionary action for which CEQA requires notice to the public and surrounding residences.

The major benefit of the General Winery Permit is that it assures consistency by applying the same regulatory standards regarding discharges to all qualifying facilities. It also holds appeal for neighboring property own-



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ers worried about the long-term impacts to water quality by incorporating requirements to address ponding, runoff and erosion, and by including groundwater protection measures.

Stormwater permits

Facility construction and operation may trigger the need to obtain stormwater discharge permit coverage. These permits, which the State Board administers, are based on section 402 of the Clean Water Act.

Facility operators should be aware that construction activities resulting in the disturbance of more than one acre of land, such as excavation to construct a holding pond, or clearing and grading to build a structure to shelter equipment, require a stormwater permit.

The General Permit for Storm Water Discharges Associated with Construction Activity (Order No. 99-08-DWQ; "Construction General Permit"), addresses these non-waste producing activities.

The Construction General Permit prohibits all non-stormwater discharges, except specific "authorized discharges" necessary to complete construction activities. It also requires preparation of a Storm Water Pollution Prevention Plan ("SWPPP") to identify pollution sources and guide implementation of Best Management Practices ("BMPs") to control and prevent pollution from those sources.

A SWPPP must be developed and implemented prior to commencement of any construction activity. Monitoring is also required.

Coverage under the Construction General Permit is obtained by submitting a Notice of Intent (NOI) and site map to the State Board, which maintains the permit database. Individual permits for construction-related activities are not normally issued. Additional federal requirements, such as coverage under section 404 of the Clean Water Act, may still apply.

Another type of stormwater permit may be required of facilities that engage in specific "industrial" activities, which has been broadly defined and includes winemaking. The General Permit for Discharges of Storm Water Associated with Industrial Activity (Order No. 97-03-DWQ; "Industrial General Permit"), covers runoff created when industrial materials, equipment or locations are exposed to stormwater, including stormwater discharges from material handling sites, storage locations, and shipping and receiving areas.

The main thrust of the Industrial General Permit is to eliminate unauthorized non-stormwater discharges. To meet this goal, it requires the development and implementation of a SWPPP that both identifies sources of pollution and specifies management methods to reduce it.

The Industrial General Permit also mandates specific monitoring and reporting requirements for both stormwater and non-storm water discharges. Again, application for coverage is made by submitting a completed NOI, a site map, and appropriate fee to the State Board.

Failure to abide by the terms of the General Winery Permit or the Stormwater General Permits is a violation of the Water Code and/or the Basin Plan and may result in enforcement action by the Regional Board, including the issuance of enforcement orders requiring compliance and imposition of administrative civil liability.

Citizen suits

Even if a government agency, such as the Regional Board, believes a landowner is in compliance with water quality requirements, private persons may bring suit against the landowner. Two common bases for such suits are the citizen suit provision of the Clean Water Act (CWA) and California's Unfair Competition Law (UCL; California Business and Professions Code § 17200).

The CWA's citizen suit provision authorizes private persons to bring suit to enforce the Act's prohibitions and requirements. A CWA citizen suit may allege that a vineyard or winery is not complying with the stormwater discharge, planning, and monitoring requirements of the Industrial or Construction General Permits.

Another type of CWA citizen suit alleges that artificial ponds, used for holding wastewater and/or stormwater, discharge pollutants to a stream or river, either through overflows or by a subterranean hydrological connection, without a permit. Citizen suits may also claim

that these artificial ponds are themselves "waters of the United States," and therefore, cannot be discharged into without a permit. Such suits have been brought even where the Regional Board has approved use of the ponds through issuance of WDRs.

The CWA authorizes courts to order fines of $27,500 per violation per day, injunctive relief that can include requiring the landowner to change its facility or operations, and payment of the plaintiff's attorneys' fees by the defendant.

There are a number of ways to respond to such citizen suits. Before any suit is filed, the plaintiff must send a "60-day notice letter" to the defendant, specifying the grounds upon which it is threatening to bring suit. The mandatory 60-day period provides the recipient with the opportunity to take corrective actions, and may dissuade the plaintiff from filing suit. During the 60-day period, the landowner will usually want to retain an expert to assess the claims of violations and determine whether corrective actions are necessary and appropriate.

If a plaintiff files suit, the defendant can challenge a citizen suit on the basis of the notice letter being too general or failing to adequately specify claims, or that the plaintiff lacks standing to bring suit.

If, after corrective actions have been taken, the plaintiff nonetheless files suit, the defendant may be able to successfully defend the suit if it can establish that corrective actions made it not reasonably likely that violations would recur at the time suit was filed. This is known as the "Gwaltney" defense, after the U.S. Supreme Court case that upheld it. While substantive defenses may also be available, because the CWA is a strict liability statute, such defenses are few.

There is no "citizen suit" provision in the California Fish and Game Code or the California Water Code. But private parties may enforce the requirements of those statutes through California's UCL, which authorizes "any person" to bring suit against any "unlawful, unfair, or fraudulent business act or practice."

Because "law" is broadly defined in the UCL, private parties may bring suit under it for alleged violation of laws such as the Clean Water Act, the California Fish and Game Code, and the California Water Code, but also for alleged violation of any other water quality requirements, mandates, or orders, such as the discharge prohibitions of the Basin Plan.

Although recent decisions of the California Supreme Court have greatly limited the ability of plaintiffs to obtain "disgorgement" of profits under the UCL, injunctive relief requiring a defendant to change its facility or practices remains available. A defendant may also be required to pay a plaintiff's attorneys' fees.

Future issues

TMDL implementation

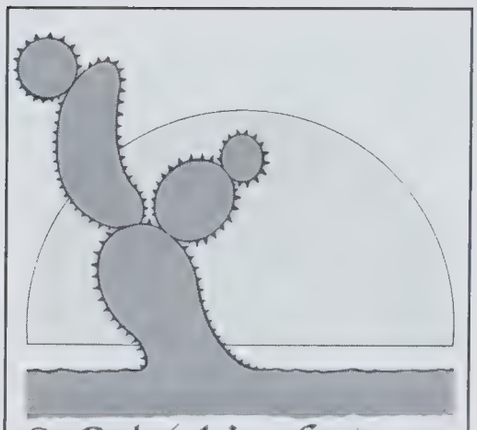
The Regional Board is beginning to implement total maximum daily loads (TMDLs) for rivers in the North Coast region that are "impaired" by pollutants, especially sediment, from "non-point" sources, as required by the CWA. Many North Coast rivers have been identified as impaired by sediment, thereby implicating land use activities such as vineyard development and operation.

The Garcia River TMDL suggests what landowners can expect. Under it, landowners from whose lands sediment is delivered to the river can choose to comply either by implementing an approved erosion control plan and an approved site-specific management plan (tailored to their property and operations), or by implementing an approved erosion control plan and the Garcia River management plan (containing more general management measures for controlling sediment).

Submission of the required plans creates a "safe harbor" so that if the management measures are inadequate the landowner will not be subject to administrative civil liability, although the Regional Board may issue a CAO to address the discharges. Since much of the focus of the Garcia River management plan is on reducing sediment delivery from roads, it can be expected that other TMDLs for North Coast rivers will have a similar focus.

Self-regulation

While several groups and task forces have attempted to address envi-



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ronmental (including water quality) issues associated with vineyard and winery development and operation, the most prominent effort to date resulted in the "Code of Sustainable Wine Growing Practices" (the "Code"), to promote self-regulation and environmental sustainability. The Code is a multi-faceted assessment tool developed by the Wine Institute and the California Association of Winegrape Growers.

Rather than champion one particular method for implementing sustainable practices, the Code provides the industry with information concerning conservation, and it proposes methods for improving community relations. Growers and owners are encouraged to engage in self-assessment to determine how they measure up to these general guidelines and suggestions.

The Code's aim is to promote sustainable practices by encouraging an ethic of social responsibility and environmental stewardship. Although the Code is industry-driven, it has received support from environmental groups.

Smaller collaborative efforts between growers and vintners, and resource conservation districts, to develop sustainability have also occurred in the North Coast counties. These advances in self-regulation and industry/government collaboration will enable growers and vintners to have a greater say in water quality regulation of vineyard and winery development and operation in the North Coast counties. ■

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Janelle E. Kellman was an associate at the firm.

INNOVATIONS AND OUTLOOK

Integration of grapevine training systems and mechanization in north-central Italy

BY **Cesare Intrieri,** Dipartimento di Colture Arboree — Cattedra di Viticoltura Sez. Viticola del Centro Interdipartimentale Ricerche Viticole ed Enologiche — Universita di Bologna
Stefano Poni, Istituto di Frutti — viticoltura. Universita Cattolica del Sacro Cuore di Piacenza

The efficiency of a new TRINOVA vertical-shaking harvester was compared in a movable spur-pruned cordon-trained vineyard.

"Integrating" training systems and machinery for mechanized vineyard management (pruning and picking) is a concept first developed at New York state's Cornell University in the late 1960s. The idea is based on two innovative components: the split-wall Geneva Double Curtain (GDC) training model, and a harvester for vertically shaking the permanent cordons via pivoting spiked-wheel heads, which transmit energy indirectly to the grape clusters in order to detach them (Figure I). The training model and the machine are specifically designed for one another in an "integrated" system.[17,18,19,20]

Principles pioneered by Cornell were introduced into Italy in the mid 1970s. Much work has gone into devising innovative training systems, often by maintaining the basic concept of the GDC, so as to enable harvesting with vertical-shaker units featuring spiked-wheel heads.[2] Italy, more than any other country, has applied the Cornell approach on a large scale to full vineyard integrated management and design.

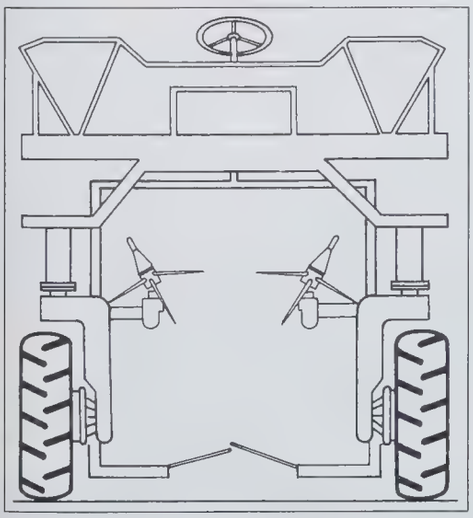


Figure I. First commercial spiked-wheel vertical-shake harvester.

Italy has experienced a sharp contraction in overall winegrape acreage since the 1980s, from more than 1 million hectares to the current 680,000 (Table I). Despite this reduction (which did eliminate many training models that were obsolete in terms of crop, quality, and technical efficiency), Italian viticulture is still composed mostly of small vineyards, though some mergers and size increases have occurred since 1980. (Table I). Vineyards currently range over 1,300 kilometres from north to south (from 46.5° to 36.5° North latitude).

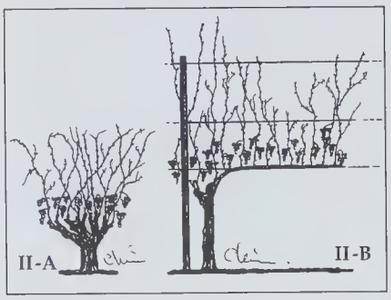
Edited from presentation to the Quality Management in Horticulture and Viticulture Symposium at Intervitis Interfructa, Stuttgart, Germany, 10–11 May, 2004.

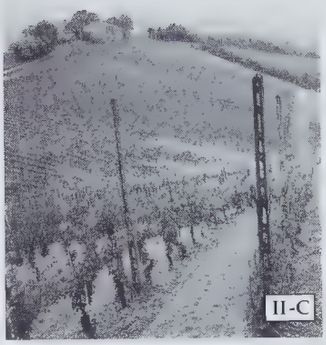
Table I: Evolution of vineyard acreage in Italy

1970:	1,109,000 hectares
1982:	1,063,000 ha
1990:	865,000 ha
1997:	788,000 ha
2000:	675,000 ha
2002:	700,000 ha
2003:	680,000 ha

Size of vineyards in Italy

1980	
Under one ha	81.5%
1–2 ha	10.5%
2–5 ha	5.4%
5–10 ha	2.1%
More than 10 ha	0.5%
2000	
Under 5 ha	85%
5–50 ha	10%
more than 50 ha	5%





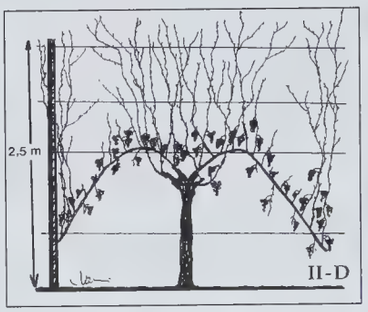
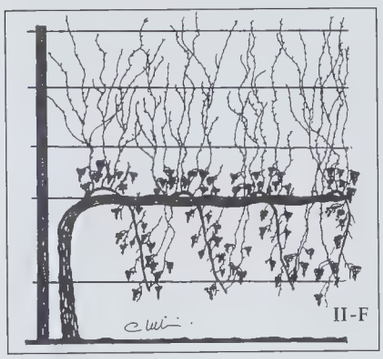
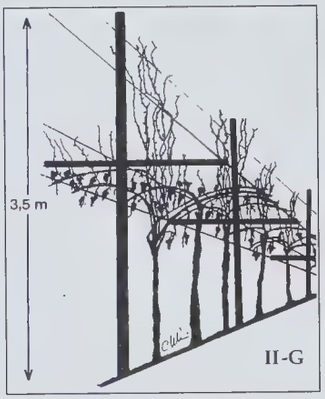


Figure II. Some traditional training systems still used in Italy: Gobelet (A); Guyot (B and C); Arched Cane (D and E); Sylvoz (F); Pergola (G and H); Raggi (I).





Vine training methods vary widely. There are still a limited number of bush or goblet vines flanked by Guyot-trained vines and Guyot variants, such as the "Arched Cane" and, in the more fertile areas, the "Sylvoz" system. Numerous other systems include the Pergola and Raggi types, which feature tall and expanded trellises and annually renewed long fruiting canes (Figure II).

Experiments have been directed for the most part at replacing these systems with permanent cordons having short spurs of two to four nodes. These changes in pruning technique rest on a number of studies which have highlighted the physiological drawbacks of long pruning.[3,5,11,16]

Renewed shoot systems, especially when the cane is bent according to the Arched Cane principle, often give rise to blind buds and to big growth differences between fruiting shoots, which means non-uniform ripening of clusters (Figure III, Table II). This is an especially big drawback in poor years.

Apart from these physiological and qualitative problems, renewed shoot systems, while permitting mechanized harvesting, are not compatible with mechanization of winter pruning. If the pruning operations have to be performed manually, 100 to 150 man-hours per hectare are required yearly.

Figure III. Long pruning and cane bending may often give rise to non-uniform fruiting shoot growth and irregular cluster ripening.

Physiological imbalance of long-cane pruning

Leaf area (m^2) per fruiting shoot of the Arched Cane system at veraison and grape soluble solids at harvest

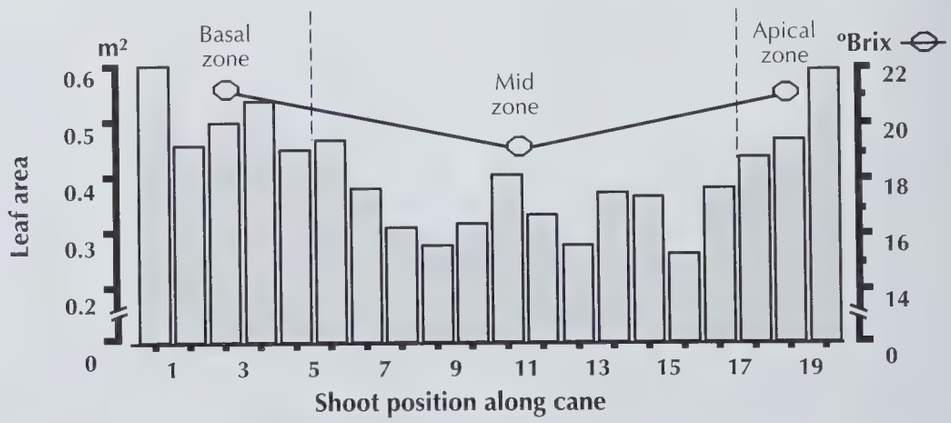


Table II: In arched cane system, shoot growth along the cane is irregular and cluster ripening growth is not uniform. Vertical bars represent the leaf area of shoots arising from buds along the arched cane.

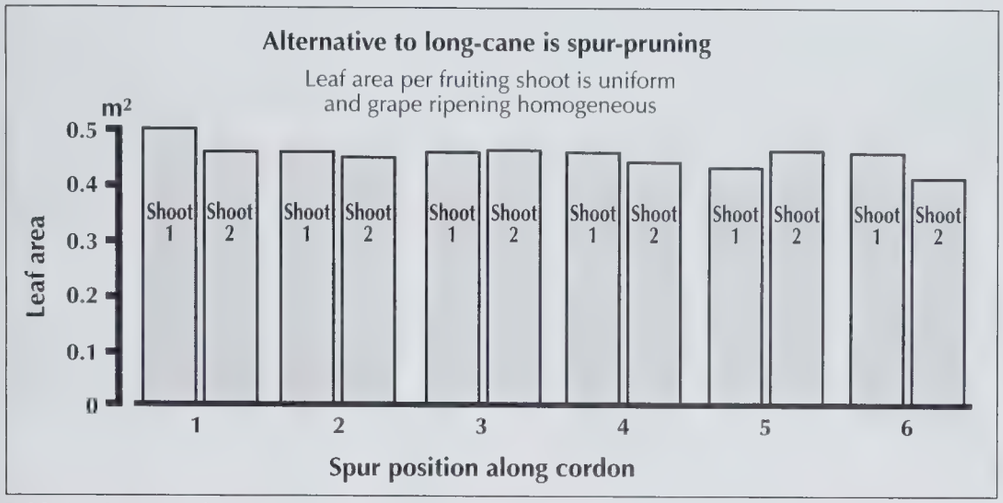
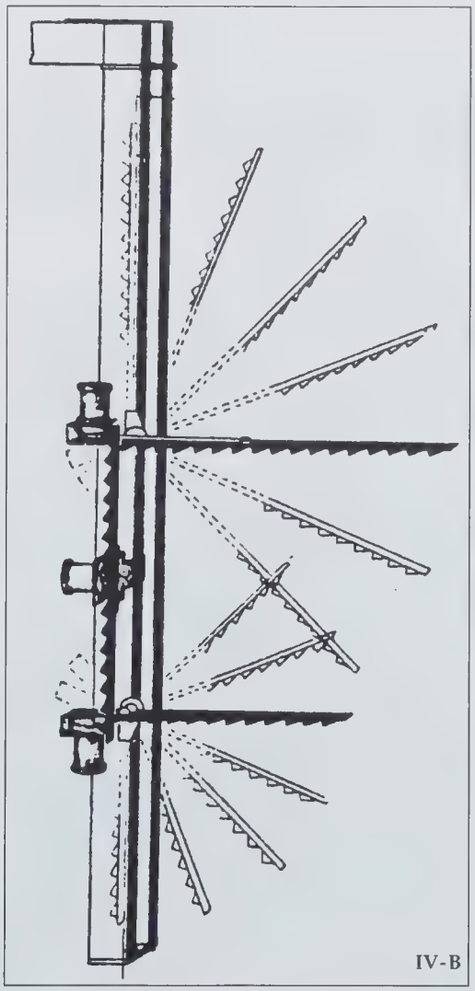


Table III: Spur number 1, 2, 3, 4, 5, and 6 along the cordon, since in the experiment, the cordon-trained vines were pruned to six two-bud spurs on each cordon. Vertical bars for shoot #1 and shoot #2 represent the leaf area of shoot 1 and shoot 2 arising from count node 1 and count node 2 on each two-bud spur after pruning.

An alternative to cane pruning is a permanent cordon system with short spurs (Table III), whose shoots have been shown to develop much more uniformly for more regular ripening. Winter pruning can also be mechanized under this system.[5]

Among the spur-pruned training systems, the GDC was considered one of the most interesting, especially for its integration with over-row vertical-shake harvesting machines.[11] The GDC has been extensively tested in Italy since 1975, and modified for a better fit with Italian conditions. Its basic structure has been altered to allow new models of multiple cutter bar units for winter pruning and the use of single-row, inter-row vertical-shake harvesters (Figures IV, V). This is a much simpler type than the over-row harvesters built in the U.S.[1] The GDC name was changed to double curtain (DC) to indicate a new version of the system.



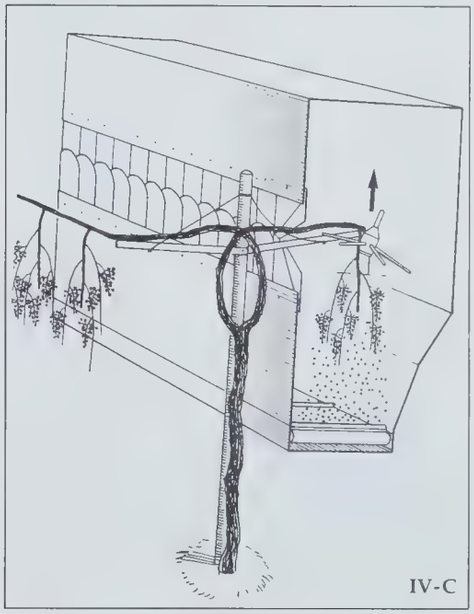


Figure IV. GDC-derived double curtain (A). Multiple cutter-bar pruners (B) and inter-row, half-row vertical-shake harvesters (C) can be used.

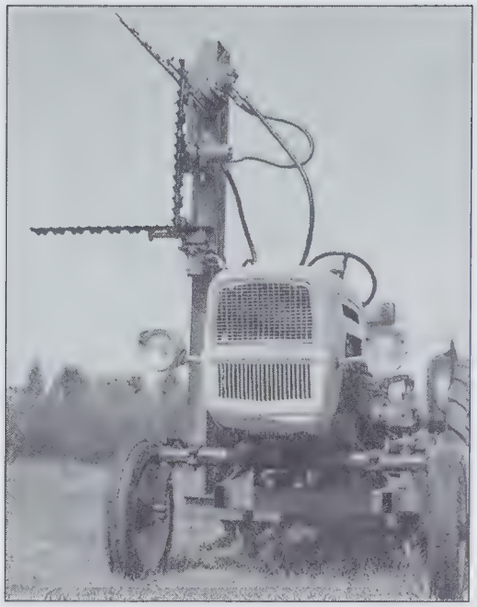


Figure V. First prototype of multiple cutter bar pruner for use on the double curtain training system.

Along with development of the new pruners and harvesters and structural changes to the DC, research has also focused on upgrading traditional hedgerow-trained vines. Among them is the classic vertical shoot positioned spur-pruned cordon (SPC), which is especially interesting since it can be harvested by traditional over-row units with horizontal shakers. Featuring shoots guided upwards, the SPC was improved by fitting it with pairs of

Figure VI. Double curtain shoot positioning is essential to improve light penetration inside the canopy. A significant simplification was achieved with rotating metal shims with plastic terminal wires that are opened before flowering and the shoots on each cordon are pushed towards the outside.

Figure VIII. The original free cordon structure. The spurs are upwardly oriented, improving upward shoot growth, and facilitating winter and summer pruning. Harvesting can be done with traditional horizontal-shake machines.

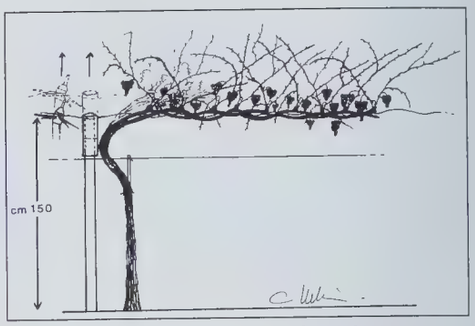


Figure IX. Movable free cordon vines are supported by a wire running through plastic caps inserted on the top of the post. The vine trunk is bowed and the system can move up and down under the vertical harvester's shaking motion.

movable support wires to keep the canopy open for better light interception.[9]

In addition, by altering certain features of the cutting-bar pruner units originally designed for the GDC, the SPC can be pruned with the same equipment, and may need only limited finishing operations in winter and no extra manual input in summer trimming.

Given its upgrade for greater mechanization, and because it normally yields high quality grapes, the SPC is among the most recommended systems, since it now incorporates many modern viticulture elements.[4,11] The SPC is particularly well-suited to less fertile soils like hillsides, in that it enables higher shoot vigor for optimum exploitation of environmental energy.

Machine-integrated systems

Apart from the SPC, the most noteworthy of the new, fully machine-integrated training systems developed in recent years are, as noted above, the double curtain (DC), free cordon (FC), free moveable cordon (FMC), movable spur-pruned cordon (MSPC), and the COMBI (a combination of systems, explained below).

Figure VII. Shoot positioning of double curtain facilitates winter pruning and improves harvester efficiency. Coiled wires help to keep cordons perfectly straight.

DOUBLE CURTAIN

In its most recent version, the DC has two permanent horizontal cordons spaced about 140 cm apart, rather than 120 cm as in the GDC. The cordons are about 160 cm above ground. Like GDC, the DC has no support wires for growing shoots. Very short spurs on the permanent cordons, after pruning, are oriented externally and downwards. It differs from GDC in that the mobile arms of the structure are not inclined upwards, but horizontally positioned to facilitate mechanical pruning (Figure IV-A).

The only manual operation required is shoot positioning to separate the two curtains and let more light into the foliage. For this, a semi-automatic method has recently been designed to reduce working time significantly. It is based on mobile metal shims with plastic and elastic terminal wires that are to be opened before flowering to push the shoots on each cordon towards the outside, leaving the central part open (Figure VI).[9]

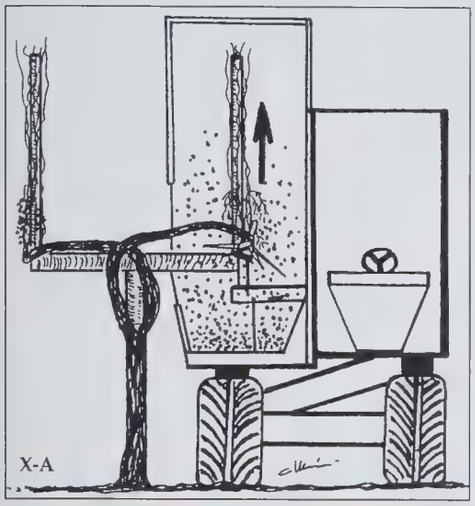
Permanent cordons are generally held by large-diameter, zinc-covered steel wires, almost always coiled. Once stretched in place, the coiled wires help keep the permanent cordons perfectly straight and parallel to the ground. This makes it easier to use multiple cutter bar units for pruning and vertical-shake harvesters (Figure VII).

Overall, compared to doing the two operations manually, machine pruning and harvesting on DC vines maintains the same yield and quality but reduces labor cost by about 90%

(Table IV).[1] The greater horizontal spacing (140 cm) between the two permanent cordons means that multi-

Table IV: Comparison of hand management and full mechanization (1991–1998 average data)

Treatment	Yield and grape quality		Labor demand				
			Man-hours per hectare				
	Yield (t/ha)	°Brix (%)	Pruning and shoot positioning		Harvesting		Total
			manual	mechanical	manual	mechanical	
Hand harvesting Hand pruning	17.0	19.7	79h 52′	0h 55′	239h 38′	—	320h 25′
Mechanical harvesting Mechanical pruning (2–4 node spurs)	18.7	19.6	17h 36′	4h 29′	—	11h 57′	33h 25′



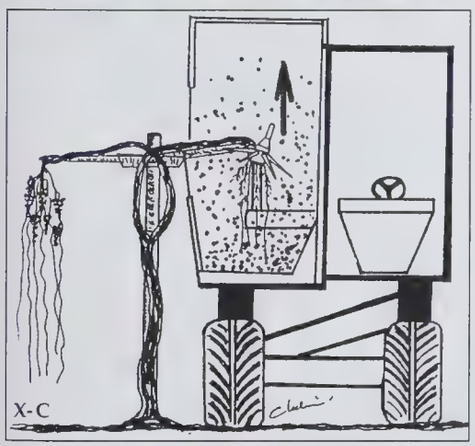


Figure X. The innovative COMBI system combining elements of the double curtain and California U-shape systems. The cordon support wires run through brackets on the sides of the U-posts, and COMBI can be harvested with the same type of half-row vertical-shake machines (A) used commercially for the double curtain (B and C).

ple cutter-bar pruners and simplified half-row, inter-row harvesters can be used on one curtain at a time (Figures IV & VII).

DC training reduces the vigor of the vines, meaning its use is advisable for very fertile land and for cultivars naturally downward growing shoots. These include Syrah, Nebbiolo, Merlot, Pinot Blanc, Pinot Noir, Ugni Blanc, Trebbiano Romagnolo, and others.[12,15]

However, use of the semi-automatic shoot positioning device means that the DC system can be used with other varieties including Chardonnay, Sauvignon Blanc, Cabernet Sauvignon, Cabernet Franc, Carménère, Sangiovese, Montepulciano, Nero d'Avola, and others.

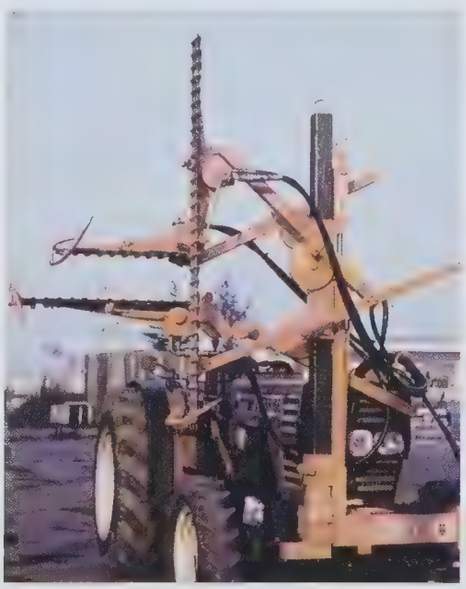


Figure XI. The multiple cutter bar unit commercially used for double curtain can also be used on the COMBI system for summer trimming.

FREE CORDON and FREE MOVABLE CORDON

FC and FMC systems are based on the same principles as the DC, in that there are no support wires for the shoots, but no shoot positioning is required.[11,12] FC has a permanent horizontal cordon fixed to a single support wire running along the top of the stakes at about 150 cm above ground. Position of the spurs is very important, which, during the training period, must be carefully trained upwards to promote upward canopy growth and make it easier for multiple cutter-bar units, especially for summer and winter pruning (Figure VIII). Pruning in winter and summer can be fully mechanized, using the same pruning

Figure XII. The multiple cutter bar machine used for winter pruning of the COMBI system. The efficiency of the pruning unit was improved by mounting an automatic feeler to avoid the U-shape posts (A and B).

TWO VOLUMES

New edition of wine industry lab book

The book formerly known as *Techniques for Chemical Analysis and Quality Monitoring during Winemaking* has been updated and re-written in two volumes to better cover more wine laboratory content.

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Monitoring the winemaking process from grapes to wine: techniques and concepts

Volume II by Patrick Iland, Nick Bruer, Andrew Ewart, Andrew Markides, and John Sitters, provides coverage of concepts, tests, and techniques that winemakers use to monitor wine style/quality indicators throughout the winemaking process. The book includes techniques for tasting grapes, winemaking operations including fermentation concepts, additions, fining trials and stability tests, and sensory evaluation of wine. The 120-page plastic-coated book is suitable for daily use by winemakers.

■

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Free Movable Cordon
TRINOVA II-harvester: trials
Vintage quality (average of cultivars)

Vintage quality	Berry (%)	Bunch or part of (%)	Free must (*) (%)	Debris (leaves, etc.) (%)
White Cultivars (Chardonnay, I.M. 6.0.13., Riesling r.)	71.8	24.9	3.3	Traces
Black Cultivars (Carménère, Cabernet f., Cabernet s.)	91.4	4.6	4.0	Traces

(*) Free must collected in 30 minutes from harvest

Table V: Vintage quality evaluation in several grape varieties, free movable cordon-trained and harvested by TRINOVA vertical shaking unit. A certain amount of whole bunches or parts were collected, free must was very low and debris was practically absent.

units as for the DC vines, while harvesting can be done with traditional horizontal shakers.

FMC differs from FC in that a plastic cap (usually a piece of irrigation pipe of proper diameter), is inserted on top of the supporting stake. The main support wire, usually of the coil type, runs through the cap to ensure that the permanent cordon stays straight and parallel to the ground. At the same time, the vine's trunk is bowed along the row direction to provide a degree of elasticity (Figure IX). This means it can oscillate freely so that harvesters with vertical-shaking heads can work without damaging vines.

Traditional horizontal shaker harvesters can also be used for FMC, but better results and less damage to grapes, especially low must, can be obtained by vertical shaking method (Table V). There is no damage to shoots or buds with a new type (TRINOVA-harvester model) of vertical shaking machine.[6,11] An over-row pruning unit (TRINOVA-pruner model) has also been designed for this training method, and has proven to be very efficient.

FC and FMC give the shoots less vigor than SPC and more vigor than DC. They can be used in several Italian growing areas. Most appropriate varieties are those with an upward shoot growth habit such as Cabernet Sauvignon, Cabernet Franc, Carménère, Terrano, Sangiovese, Montepulciano, Chardonnay, and Sauvignon Blanc. Conversely, FC and FMC are not advisable for grape varieties such as Ugni Blanc, Merlot, and Pinot Noir, which have a marked downward growth habit.

MOVABLE SPUR-PRUNED CORDON

Positive results and quality advantages enabled by the principle of vertical shaking as used for DC and, more recently, for FMC vines, led to testing the

Movable Spur-Pruned Cordon
TRINOVA III-harvester. Preliminary trials (2001)
Vintage quality (average of cultivars)

Harvest products	Berry (%)	Bunch or part of (%)	Free must (*) (%)	Debris (leaves, etc.) (%)
White Cultivars Ansonica, Bombino, Chardonnay, Garganega, Pignoletto, Pinot gris, Verdicchio, Vermentino	79.5	14.2	4.0	2.3
Black Cultivars Aglianico, Cabernet s., Carménère, Montepulciano, Negro amaro, Nero d'Avola, Primitivo, Raboso piave	77.3	17.0	2.3	3.5

(*) Free must collected in 30 minutes from harvest

Table VI: Vintage quality evaluation in several white and black grape cultivars trained to movable spur-pruned cordon and harvested by TRINOVA-III unit. Preliminary trials showed that a certain amount of whole bunches or part of them were collected, and free must and debris were very low.

Movable Spur-Pruned Cordon
Harvest trials (2003)
• horizontal shaking (traditional harvester) • vertical shaking (TRINOVA III)
Vintage quality (average of cultivars)

Harvest products and harvesting methods		Berry (%)	Bunch or part of (%)	Free must (*) (%)	Debris (leaves, etc.) (%)
White Cultivars Tocai friulano, Chardonnay, Pinot blanco, Verduzzo friulano, Verduzzo trevigiano	Horizontal shaking	86.1	3.5	9.3	1.1
	Vertical shaking	80.5	15.7	3.6	0.2
Black Cultivars Pinot grigio, Pinot nero, Merlot, Cabernet s., Cabernet f., Carménère, Raboso piave, Raboso veronese	Horizontal shaking	81.8	9.9	6.8	1.5
	Vertical shaking	73.0	23.7	2.9	0.4

(*) Free must collected in 30 minutes from harvest

Table VII: Vintage quality evaluation of several white and black grape cultivars harvested by horizontal and vertical shaking units on movable spur-pruned cordon trained vines. The vertical shaking method clearly increased the amount of whole bunches or part of them in the vintage, while free must and debris were always decreased.

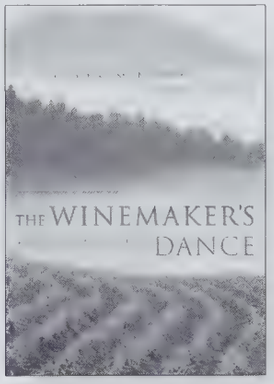
same technology on other vine training methods. These include modifications of both traditional and completely new methods.

The vertical shoot-positioned MSPC is the most interesting variation of the traditional vertical shoot-positioned SPC. Wire carrying the permanent cordon runs through brackets on the side of the stakes so that the cordon and the wire can move up and down freely under the action of the vertical shaking heads. This system thus bows out the vine trunk, as in the FMC, so as to give the cordon's horizontal section upward elasticity and allow it to move easily, thus avoiding vine damage.[9]

The first tests of this system occurred during the 2001 harvest on different varieties with an over-row vertical shaker TRINOVA unit, modified to work on very low permanent cordons at about 70 to 80 cm above ground. The results were excellent for harvesting efficiency, with a further reduction in grape loss and vine damage, and improvement of product quality. A large proportion of bunches detached whole, with little free must and limited debris (Table VI).

Continued on page 82

"A page-turner on wine and geology? Here it is....



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Euro-Machines Inc.

Euro-Machines introduced the new BRAUD VL Grape Harvester in 2004. State-of-the-art technology provides the perfect blend for top quality harvesting and full multi-function capability. The cab is sealed and pressurized for noise reduction and spray safety. A new multi-function lever controls all harvester functions with preset picking programs and all multi-function attachments. Hydrostatic transmission with cruise control is standard.

The harvester head has a patented quick-shaker rod engagement; this enables activation of more or less shaker rods as the fruit zone requires. Varying leaf volumes of the vine, picking conditions, and grape varieties are easily handled by the operator viewing the picking process on a color monitor. Adjustments are just a fingertip away on the multi-function lever. Four highly efficient cleaning fans on the harvester eliminate all leaves.

For optimal cleaning efficiency, an optional patented destemmer makes it possible to destem and eliminate any MOG. The result is the cleanest fruit delivered to a winery done by machine harvesting.

For more information, contact:
Euro-Machines, Inc.
East: 540/825-5700
West: 4950 E. Fulton Dr., Cordelia, CA 94534
tel: 707/864-5800; fax: 707/864-5879
e-mail: mattateuro@aol.com
website: www.euromachinesusa.com

PLEASE SEE EURO-MACHINES AD, PAGE 46.

Rohrer Manufacturing

Man-Saver T-Post Driver takes the hard labor out of fence building and saves hours of exhausting work. From rocky soil to hardpan, this revolutionary, affordable tool, works in the most difficult soil conditions, making post-driving a safe and easy one-person job. Customized interchangeable adapters enable driving almost any wooden or metal shaped posts (up to 3½ inch diameter). If necessary, additional customized adapters can be manufactured to fit your needs.

Man-Saver patented, pneumatic post drivers feature durable steel construction with an operating speed of 80 to 85 strokes per minute. They operate off any small air compressor that delivers at least 2.2 cubic feet of air at 125 PSI. The compact size makes remote locations and tight spots accessible.

Man-Saver drives posts without bending and will work wherever a 35 lb. hand driver is used. Drivers range in weight from 26 lbs for the basic T-post driver to 48 lbs (largest model). All drivers come with a 90-day warranty for individuals and a 30-day warranty for commercial fence builders.

Additional product information and the entire line of Man-Saver post drivers and sleeves are available for purchase online at www.rohrermfg.com. Prices start at $450.

For more information, contact:
Rohrer Manufacturing, Inc.
Dan Rohrer, President
tel: 541/548-7746, or
toll free: 800/438-7599 (access code 03)

PLEASE SEE ROHRER MANUFACTURING AD, PAGE 34.

Weed Badger Division

The Weed Badger Division announces the Model 4020-SST in-the-row tiller. The new model features a new R/E control console and an all-new hydraulic system with active cooling. The new design puts override control of the retract/extend functions and on-the-go tilt control at your fingertips. The new console makes mounting and dismounting of equipment a snap — even onto a tractor with a cab.

The 4020-SST makes in-row weed control without toxic chemicals easy. It is the solution to the hand-labor weeding hassle. The new active cooling system allows multiple shifts of personnel to operate the equipment on large acreage. Grape growers can cleanup vine-row strips and reduce potential damage and disease from sharpshooters and other insect pests, rodent pests, and fungus problems.

Weed Badger equipment is manufactured in the U.S. The company has supplied in-row tillers and mowers factory-direct to grape growers since 1979. Call for a free DVD or video.

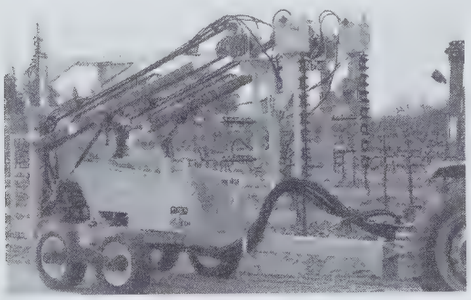
For more information, contact:
Weed Badger Division,
Town & Country Research
& Development, Inc.
Ron Dalka
5673 95th Ave. SE, Marion, ND 58466
tel: 701/778-7511, toll-free: 800/437-3392;
fax: 701/778-7501
e-mail weedbadg@drtel.net
website: www.weedbadger.com

PLEASE SEE WEED BADGER DIVISION AD, PAGE 8.

OXBO International Corp.

vMech System

The vMech System by OXBO consists of the 2220 Tool Carrier and many different attachments to fully mechanize the most labor-intensive cultural practices in today's vineyard.



For 2005, OXBO introduces Finish Pruning attachments for the vMech System. The Finish Pruning system allows growers to mechanize the normally labor-intensive dormant season spur-pruning operation. Attachments for Finish Pruning are a precision pruning system that are used to maintain vine shape and capacity and reduce MOG. The process requires only minimal hand clean-up to remove loose brush and make final cuts around trellis obstructions.

The vMech 2220 Tool Carrier was designed with a quick-attach for convenient setup of all available implements. Minimum tractor row width for the Tool Carrier is six-feet, and the carrier is able to handle slopes up to 25%. Currently, attachments for Finish Pruning, Shoot/Cluster Thinning, and Fruit Thinning are available. Other attachments are being developed.

As a part of OXBO's Vineyard Solutions line, the vMech System is ideal for growers looking for high quality fruit, increased vineyard control, and maintain competitiveness in today's market.

For more information, contact:
OXBO International Corp.
Vineyard Products
270 Birch Bay Lynden Rd.
Lynden, WA 98264
toll free: 888/6-KORVAN
California reps: Mitch: 559/285-5804,
or Scott 559/392-1341
e-mail: korvan@korvan.com
website: www.korvan.com or
www.oxbocorp.com

PLEASE SEE OXBO INTERNATIONAL AD, PAGE 55.

Durand-Wayland, Inc.

Durand-Wayland, Inc is a leading manufacturer of PTO sprayers for vineyards. From economical three-point hitch models to a new SilverLiner R32/400 model, Durand-Wayland's sprayers are designed to deliver optimum protection for grapes. The model 3P50-24 features a three-position, 24-inch axial-flow fan, 50-gallon polyethylene tank, and 10.5 gpm diaphragm pump. The model 3P100-32 has a three-position, 32-inch axial-flow fan, 100-gallon polyethylene tank, and an 18.9 gpm diaphragm pump. Both are ideal for small operations.

The SilverLiner R32/400 has a 400-gallon stainless steel tank and is perfect for large, mature vineyards. A unique "reverse fan" design increases the area of the air-intake four-fold, and helps eliminate accumulation of leaves and debris at the rear intake guard. The SilverLiner R32/400 is also equipped with a patented "SureTrac" tracking hitch to help keep the sprayer and tractor in alignment, allowing for tighter turns under full power. Options for the SilverLiner R32/400 include: vineyard towers, lower air scoops, electric valves, and gun-outlet kits.

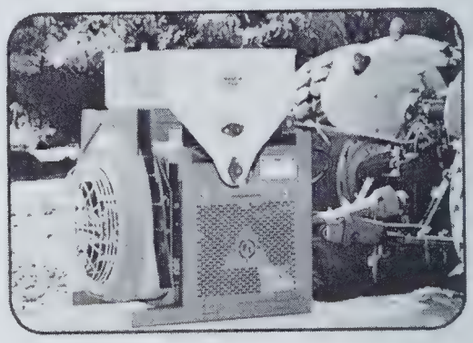
Options for three-point hitch models include: stainless steel top and bottom "V" air deflectors, one-way stainless steel volutes with nozzle kits, cable control discharge for one-way volute, two-way stainless steel volutes with nozzle kits, and ceramic nozzle conversion kits.

For more information contact:
Durand-Wayland, Inc.
Rick Cordero
PO Box 1404, LaGrange GA 30241
tel: 706/882-8162, toll free: 800/241-2308;
fax: 706/884-3268
e-mail: sales @durand-wayland.com
website: www.durand-wayland.com

PLEASE SEE DURAND-WAYLAND AD, PAGE 27.

Flory Industries

Flory Industries, a leading agricultural equipment manufacturer since 1936, has engineered the Flory *Pow'r Flo* Dusters for sulfer dust application, and the Flory 1000 Series Flail Mowers for maximum efficiency in vineyard management.



The Flory Model D-20 3-point Duster and TD-20 Tow Duster feature continuous positive-flow and a quiet double-sided centrifugal fan for uniform coverage. Flory's field-proven fan design produces an even discharge, virtually eliminating "hot spots" during sulfur application. These units are compact in size for narrow rows, yet powerful enough to handle wide rows. The stainless steel hopper and metering components, plus heavy–duty gearbox, ensures years of trouble-free operation.

Flory 1000 Series Flail Mowers are built for durability with a ¾" endplate thickness, ¼" case thickness, and rigid tubular frame. Each mower is equipped with forward rotation and heacy-duty industrial knives. They are available in cutting widths ranging from 54-inch to 90-inch and options include scoop knives and reverse rotation.

For more information, contact:
Flory Industries
PO Box 908, Salida, CA 95368
tel: 209/545-1167; fax: 209/543-7646
website: www.floryindustries.com

PLEASE SEE FLORY INDUSTRIES AD, PAGE 42.

OXBO Vineyard Solutions GreenTech

OXBO offers the GreenTech Spray System line of sprayers for growers looking for effective, quality coverage in their spraying operation.

GreenTech sprayers utilize unique, high-volume, electrically driven prop-style fan heads to deliver a high volume of air to provide maximum coverage. Each head contains eight adjustable nozzles with angled heads to minimize chemical waste and maximize control over your spraying operation. With the electrically-driven fan heads, there is no risk of oil contamination from the sprayer.

For 2005, OXBO is offering several different GreenTech models. Tow-behinds are available in 110-, 230-, and 530-gallon designs. Each sprayer can be customized to fit your needs and applications. OXBO also offers the GreenTech three-row model designed to fit a Gregoire G120/G140 chassis.

Other benefits of the GreenTech sprayers include high-speed application, the ability to spray effectively in windy conditions, and a well-built, rugged sprayer chassis. All GreenTech sprayers are backed by OXBO's service and parts network.

The complete line of GreenTech sprayers is part of OXBO's Vineyard Solutions line, providing growers with year-round solutions for the vineyard.

For more information, contact:
OXBO International, Corp.
Vineyard Products
270 Birch Bay Lynden Rd.
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toll free: 888/6-KORVAN
CA reps: Mitch: 559/285-5804,
or Scott: 559/392-1341
e-mail: korvan@korvan.com
website: www.korvan.com or
www.oxbocorp.com

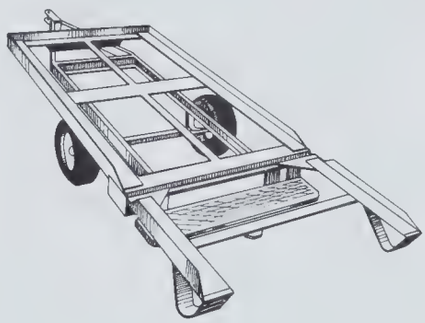
PLEASE SEE OXBO INTERNATIONAL AD, PAGE 55.

Western Square Industries

Western Square Industries manufactures vineyard bins, trailers, and wine barrel racks.

Western Square's two-ton vineyard bins are manufactured in stainless or mild 14-gauge steel. The sides, endwalls, and bottoms are lap-welded to ensure strength and watertight integrity. The D-ring end is ribbed to transfer the stress of hoisting to the entire height of the bin end. Mild steel bins are powder-coated in a variety of colors with an FDA-approved, foodgrade epoxy inside. These and other features ensure years of trouble free use.

Western Square vineyard trailers are offered in six styles designed for narrow or wide vineyard rows. Trailer configurations accommodate two-ton harvest bins or up to three 4-by-4 plastic bins. Several styles are outfitted with ramps and plastic slides to drop bins without needing a forklift, facilitating a speedy return to the harvest. A new tilt trailer design eliminates the need for a hydraulic lifting mechanism. Simplicity of design and a durable powder coat finish contribute to easy maintenance. Add a 4-by-8 sheet of plywood and the trailer becomes a utility trailer for off-season projects.



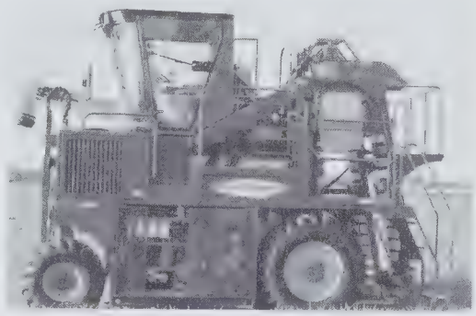
All Western Square products are manufactured in America.

For more information, contact:
Western Square Industries
Trygve Mikkelsen
1621 N. Broadway, Stockton, CA 95205
tel: 209/944-0921 or
inside California: 800/367-8383;
outside California: 800/367-7810
website: www.westernsquare.com

PLEASE SEE WESTERN SQUARE AD, PAGE 64.

Korvan Harvesters OXBO International Corp.

Korvan harvesters are the American-made grape harvesters backed by a commitment to customer service and parts availability. This commitment has helped Korvan harvesters become the best selling grape harvesters in the U.S. wine, raisin, and juice markets for the past five years.



For 2005, OXBO introduces a new Korvan grape harvester, the Korvan 3016XL. The 3016XL was designed as a heavy duty harvester with a 22-inch longer catching area, allowing growers to harvest at higher speeds. The 3016XL also has 4-inch wider kicker- and cross-conveyor belts for cleaner fruit when picking higher tonnage. The new harvester has larger bearings on the head posts, a larger ball joint with a stronger connection to the beater post, and other harvester improvements.

All Korvan harvesters utilize a bucket conveyance system and soft-touch bow rod harvesting system that gently carry grapes to the gondola, giving more clean, whole fruit than any other machine on the market. Because Korvan doesn't drag your grapes, Korvan harvesters pick the fruit winemakers love.

With the addition of the Korvan grape harvesters to OXBO's Vineyard Solutions line, OXBO now offers all of the quality products growers need in today's vineyards.

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Anderson Agri-Forest Equipment, Inc.

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Rabaud, a premier European manufacturer of equipment for vineyards and agricultural businesses, has been located in Vendée (northwest French coast) since 1980.

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toll free: 866/6810550; fax: 450/240-0552
e-mail: stephen@andersonagri-forest.com
website: www.rabaud.com

PLEASE SEE ANDERSON AGRI-FOREST AD, PAGE 24.

Bubco, Inc.

For 10 years, Bubco, Inc. has supplied specialized equipment to the vineyard industry. Through a network of dealers across the U.S., Bubco offers a complete service for the Collard Raptor leaf remover.

The Collard Raptor, introduced five years ago to the California market, has gained popularity as a premier vineyard leaf removal machine. The Raptor removes leaves as early as possible (fruit set), enabling grapes to benefit from early exposure to sunlight. Grapes are enriched with anthocyanins and phenolic compounds. One can thus obtain grapes more suitable for producing great wines.

Grape bunches are also cleaned by the removal of dead flower parts and other debris. Aeration of the fruit zone and exposure of grape bunches to the sun prevent rot and improve the efficiency of treatments. The Raptor pneumatic system also removes leaves from the interior of the vines whereas vacuum systems only remove leaves from the outside.

Collard offers front and rear tractor-mount models in single or two-row configurations. The High Clearance Raptor for over-the-row tractors is available for a two or four-row machine.

For more information on Collard Raptor leaf removal machines contact:
Bubco, Inc.
PO Box 1840, Lodi, CA 95241
toll free: 800/474-2532
website: www.bubco.com

Terra Spāse, Inc

Terra Spāse, Inc, thanks to a partnership with John Deere and Soil & Topography Information, announces a new Soil Information System™ (SIS) that represents a new approach to soil analysis, mapping, and management for vineyards.

The SIS system combines state-of-the-art soil physical data collection technology (texture, compaction, water holding capacity) with chemical analyses to create the most detailed and accurate maps of soil variability commercially available. Products include soil maps that can be used to support vineyard management fertility and irrigation practices in vineyard layout and irrigation system design, varietal and rootstock selection, soil preparation, and soil amendment and fertilizer applications.

Soil Vigor Potential Plus™ and plant-available water maps can also be used for trouble shooting and for directing canopy management, fruit thinning, and selective harvest decisions, saving valuable labor and improving vineyard efficiencies.

Terra Spāse products include: near real-time North Coast weather data and vineyard-specific maps of vine water status, soil moisture holding capacity, and NDVI maps of vine canopy density. Weather data for Napa and Sonoma counties and Fox Weather products are available online at www.terraspase.com.

Terra Spāse's two reports (*Soils and Wine Grapes in the Napa Valley AVA* and *Weather and Wine Grapes in the Napa Valley AVA*), on the soil and weather conditions in Napa Valley AVA can be ordered from Terra Spāse.

For more information, contact:
Terra Spāse, Inc
345 La Fata St., Ste D, St. Helena, CA 94574
tel: 707/967-8325; fax: 707/967-8596
e-mail: terraspase@earthlink.net
website: www.terraspase.com

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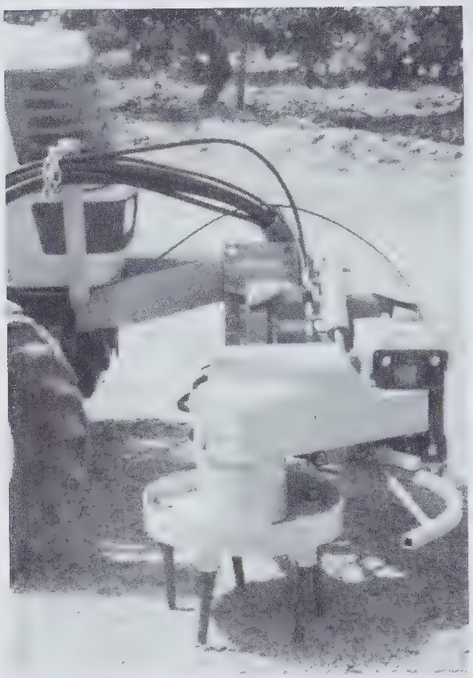

Now that the vineyard industry has made a turn toward better returns to the grower, this is a good time to evaluate methods to sustain profitability. A consideration of mechanical in-row weed control is valuable. Both in-row tilling and in-row mowing are cost-effective alternatives to the use of chemicals.

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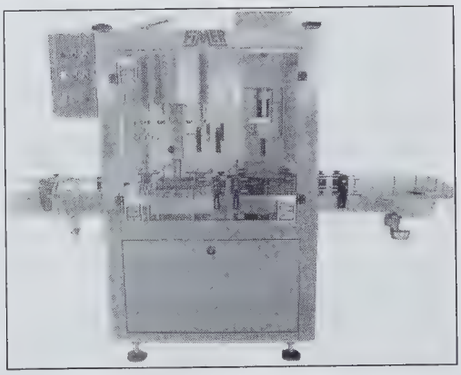

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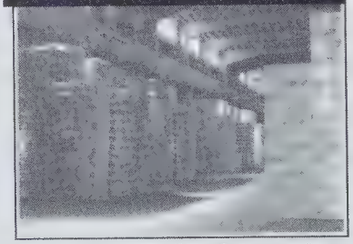

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Continued from page 34

beyond your time. It is time well spent to look for signs of both excess water stress and, on the opposite extreme, signs of excess vigor brought on by too much easily extractable water.

By far, shoot tips are the best indicators of water status, especially (and primarily) between bloom and veraison (when we are trying to restrict shoot growth). Shoot tips are easy to observe just by driving past, although more thorough examinations are best.

Shoot growth ceases at about –11 bars of water potential, but will show signs of slowing at –9 or –10 bars (Figure II). Beyond about –14 bars, shoot tips will dry up. This is not a bad thing if the shoots are long enough and have enough leaves to ripen the crop. Like the pressure chamber, shoot tips may be used as a "speedometer" for irrigation management, although they are not useful after growth ceases.

At Gallo of Sonoma, a rating system is used to describe and log shoot tip condition (Figure III). There are other systems in use, but they are all very similar in concept.

As discussed in Section A, a very good method for assessing vine water stress early in the season is to monitor shoot elongation rates using numerous marker shoots within a vineyard block. Shoot growth will slow down and then stop — usually before the shoot tip symptoms appear.

Other visual indicators include tendrils, which droop when the vine is water-stressed. Tendrils are useful only before veraison, however, as they become tough and woody afterwards. Basal leaves (leaves closest to the base of the shoots) will abscise (turn yellow, dry up, and fall off) when a vine is under water stress. This is undesirable, as leaves are needed to protect the fruit from the sun and for production of sugars for ripening. Hence, yellowing leaves are usually a sign of over-stressed vines, although a small amount of leaf abscission — no more than one to two leaves per shoot — may be allowable if it occurs late in the season.

Leaf blade-petiole angles will change under water stress, as the vine is programmed to avoid sun exposure at such times. This mechanism helps prevent overheating of the leaves. Under high water status (not stressed), the petiole makes a 90° angle with the leaf blade. The angle becomes smaller and the leaf folds slightly under high levels of water status. This is another indicator of an over-stressed condition — vines in this state are not very productive.

However, some varieties, such as Cabernet Sauvignon, do not express this symptom readily. Thus, it is not a very reliable indicator of water status. Actually, all of the visual symptoms of water stress are "lagging indicators" in that they express themselves *after* the vine has experienced some stress.

The fruit can be used as an indicator of water status although, again, fruit-stress symptoms are often an indication of an over-stressed condition. Before veraison, fruit water-stress symptoms include flaccid or shriveled berries in the afternoon. This is not necessarily an over-stressed symptom, though, if the berries regain turgidity in the evening. In fact, this condition can lead to small berries that will make a more highly structured red wine, if desired.

After veraison, puckering or shriveling berries are usually an over-stressed condition. During ripening, flaccid or shriveling berries will *never* recover their turgidity and can result in severe loss of both yield and wine quality.

However, it is important not to confuse shrivel due to water stress with shrivel due to other conditions. Shrivel due to water stress will be seen on fruit all over the vine, while fruit shrivel due to overexposure to sunlight (heat stress) will be most prevalent on the afternoon-sun side of the canopy.

Fruit shrivel due to bunch-stem necrosis will be accompanied by a dried out rachis, while water-stress shrivel will retain a green rachis. Since fruit shrivel during ripening is potentially catastrophic, it should be monitored but not used routinely as an irrigation guidance tool. Late in the season, the pressure chamber is really the only reliable tool for vine water status feedback. ■

Section C — Irrigation Strategy will appear in May/June 2005 ***PWV***.

The author wishes to thank the Gallo family for their tremendous support and the staff of Gallo of Sonoma Winery & Vineyards for their substantial contributions. Special thanks to Jim O'Donnell for his invaluable efforts on the research projects. Additionally, the content reviews from Stan Grant, Jeff Lyon, Steve Matthiasson, and Kirk Grace are sincerely appreciated.

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Web Sites

California Irrigation Management Information System (CIMIS): www.cimis.water.ca.gov/

UC Davis IPM — California Weather Databases: www.ipm.ucdavis.edu/WEATHER/weather1.html

PERSONNEL POINT OF VIEW *by Anne Heron*

Effective use of performance reviews

"I dread this time of year!" Pamela exclaims. It's time for her to do performance reviews. "I have so much on my plate right now. I just don't have time for all this paperwork!"

The winery where Pamela works as tasting room manager schedules performance reviews for all employees at the same time of year. Senior management feels that this is the best way to ensure consistency in the evaluations, and the timing allows them to align the assessment of individual performance results with those of the winery. Pamela thinks this approach is a great idea, but she wants to make sure that her performance reviews are more than just a "paperwork" exercise.

"I ask myself how I can make my reviews more useful," she explains. "I figure that one way is to use these reviews as an opportunity to have a conversation with my staff about what's important in their jobs and how they make a difference to the winery. It'll also be a time to celebrate accomplishments and talk about development needs." I agree with her approach. It will make the reviews more valuable — both to her and to the staff.

"WHAT CRITERIA WILL YOU EVALUATE?" I ask. Pamela shows me the form that the winery has created. It has two main categories — job performance and performance factors. "The performance factors section of this review format," explains Pamela, "is very interesting to me.

"In other companies, I've been asked to evaluate behaviors, such as 'teamwork' or 'communication,' so I'm used to that. This form, however, evaluates employees on demonstrating the values of the winery — quality, customer service, leadership. I really like this. It means that everyone in the winery is going to be focused on the same things.

"Maybe it is just semantics, but I think using the same words and concepts to describe the behavior we expect from our employees and the behavior we expect from the winery is very powerful. It gives me the opportunity to reinforce the importance of our values and culture with each employee and to discuss how each of them can demonstrate these values in his or her day-to-day job."

She goes on to tell me about some things that she did earlier in the year to bring the values to life within her department. For several weeks, she devoted time at each staff meeting to one of the values. She asked employees to identify ways that they could demonstrate the value in their work and to create standards of performance that would help them achieve excellence in this area.

Pamela grows thoughtful, "The standards they created will be very useful to me now as an evaluation tool — for each individual and for the department overall. Perhaps I'll ask the team to give me feedback about how well they've done in each area."

"WHAT INFORMATION WILL YOU GATHER TO WRITE THE REVIEW?" I ask. Team input would be useful for a discussion of department results. What about the individual?

Pamela decides to create a short "self-evaluation" form for her staff to complete, asking them to provide their assessment of the year's performance in three areas.

First, their goals — what was accomplished during the year that they are most proud of? What did they set out to do, but have not accomplished? What goals will they set for themselves next year?

Second, their skills — their strengths and skill areas that they'd like to develop.

Finally, their suggestions for the winery — what could the winery do better?

These self-assessments will provide input to Pamela's evaluations. More important, they will help Pamela know if she and the employee are on the same page about that employee's performance.

Pamela considers what other information she can use — tasting room sales records, wine club sign-ups, her observations noted throughout the year, feedback from other managers, customer comment cards, etc. She identifies a number of good sources.

She realizes that it is important to look at the whole year, not just the last few months. "It's so easy to just focus on what's going on right now," she muses. "Take Sam for instance. Most of the year, he's been really great — coming in early, taking extra shifts to help out. The last few weeks, though, he's been getting here late. He moved and is having trouble judging the commute. If I'm not careful, I'll let my frustration with this recent performance color how I look at the whole year!"

"WHAT TIPS DO YOU HAVE FOR WRITING THE REVIEW?" Pamela asks me. "Managers often ask how they can be objective in their comments," I reply. "The best way is to describe what you observe, its impact, and, if necessary, what change you'd like to see."

I ask Pamela how she will prepare Sam's evaluation on attendance. She pulls out his form. "Well, what I have here is 'Sam was reliable in attendance most of the year. However, recently, his dedication to the job has declined.'" Pamela thinks about this statement and realizes that, by describing Sam's tardiness as a "lack of dedication," she is drawing a conclusion that might not be true, and one that might cause Sam to get defensive.

If she describes what she observes and its impact, she'll be more likely to help Sam see that improvement is needed. "I think I'll rewrite that last sentence," she says. "How's this? 'However, during the past three weeks, Sam has been late every day, which has made it necessary for his co-worker to work overtime to provide coverage. Sam needs to improve his attendance.'"

Pamela and I discuss some other tips to help managers be objective in their evaluations:

- Focus on job requirements and job performance criteria,
- Evaluate performance, not personality,
- Avoid personal judgments,
- Provide examples of performance,
- Be candid and honest.

"WHAT ABOUT ADDRESSING ATTITUDE?" Pamela describes a problem she is having with one of her employees. "He knows a lot about the wine and is great at sales. But he isn't a team player. He won't help out new staff members. He acts as if it's beneath him to educate them about the wines or to help

them build their sales skills." Pamela doesn't know how to effectively give him feedback on this aspect of his performance.

"You can use the same formula as you used with Sam's attendance," I suggest. "Describe your expectations, your observations, the impact of his performance, and what you'd like to see changed." Pamela explains that she expects Troy to help the newer staff members and share his knowledge and expertise. As a result of Troy's current performance, it is taking a longer time for the new staff to get up to speed, which is reflected in the department's sales numbers.

"I need to point this out to Troy. If he was helping his staff, they would be making more sales. Our numbers would be up, and because of the way our incentive plan is designed, everyone would win."

As she says this, Pamela realizes that Troy might not know about her expectations. "I've always been told that a performance review should contain no surprises," Pamela remarks. "I can see how easy it is to make assumptions about what an employee knows!" The performance review meeting will give her and Troy an opportunity to discuss these new expectations and what support he might need to be successful in them.

"HOW WILL YOU HOLD THE PERFORMANCE REVIEW MEETING?" I ask what plans Pamela has made to discuss the reviews with her staff. She has reserved the conference room, so she can have the meetings in a private place and has made notes to guide the meeting, so that she will be sure to cover the important items.

Her agenda includes the following:

- Welcome the employee (Try to set him or her at ease).
- State the purpose of the meeting ("Here's the job; I want you to succeed").
- Ask their observations about the year (Get them involved in the conversation).
- Review criteria and results (expectations, observations, impact).
- Acknowledge accomplishments (and problem-solve what didn't go well).
- Discuss next steps (new department objectives, individual goals, development plans).
- Thank the employee (for time, candor, efforts during the year).

We discuss ways that Pamela might anticipate reactions of her employees during the meeting and prepare for them. One useful tool will be the completed "self-evaluation" forms. The employee's comments will provide a good indication of whether or not his or her perception of performance is the same as Pamela's.

"WHAT ARE YOUR NEXT STEPS?" I ask. Pamela looks at the stack of forms on her desk. "I'd better get started reviewing information and writing these reviews," she observes. "I've got my work cut out for me, but now I think it will be time well-spent.

"By the end of this process, my staff and I will all be on the 'same page.' We'll have a common understanding of where the tasting room is headed, how they fit in, and what I expect them to focus on. We'll be even more successful in the future, with all of us pulling in the same direction." ■

Anne Heron is a senior associate with The Personnel Perspective, a human resources consulting, training, and recruiting firm in Santa Rosa, CA. She has over 25 years of management and HR experience. Contact: 707/576-7653.

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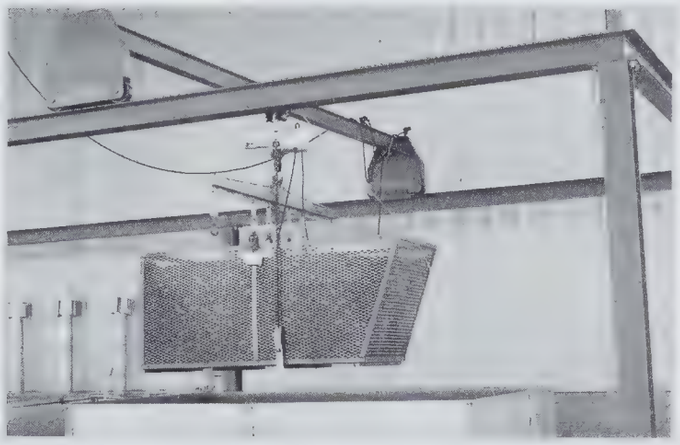

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Integration of grapevine systems

Continued from page 71

These results were confirmed during 2003 by comparing horizontal and vertical-shaking harvesting methods on several white and black grape varieties (Table VII). On the basis of these results, some large MSPC vineyards are now being planted at major wineries.

COMBI SYSTEM

The most advanced research on innovative training systems is focused on the COMBI, which combines some of the DC's structural characteristics with those of the Californian U-system.[7,8] In the COMBI system, two vertical shoot-positioned walls side by side are supported by a U-shaped structure that alternates along the row with a pair of mobile arms identical to the DC (Figure X). As in the MSPC, the cordon support wire runs through brackets, which enables the cordon to move up and down in response to vertical shaker action. The same commercial harvesters used for DC (Figure X-B, C) can be applied to the COMBI and the normal multiple cutter-bar pruners (Figure XI).

Testing in the 2002-2003 harvesting and pruning season was very successful (Figure XII) and deserves expansion to a larger scale. On the strength of the initial indications, new experimental COMBI-trained vineyards are being created with more acreage and more varieties in order to assess their physiological response and reaction to full mechanization.

Conclusions

Experimentation in Italy targeting maximum integration of training systems and mechanization is fairly advanced. In recent years, this has certainly contributed to a large increase in the number of harvesters in use, along with pruners and trimmers. There are currently about 1,500 traditional over-row horizontal-shake harvesters working on various types of hedgerow-trained vines, and about 70 vertical-shake, inter-row, half-row machines working on DC vines, but also successfully tested on the COMBI.

A recent addition has been a number of self-propelled, over-row machines derived from the original TRINOVA model using vertical shaking on FMC and MSPC vines.[6] The number of pruners is 2,000 to 3,000, with rotary knives or multiple movable cutter bars appropriate for both summer and winter work.

Italian research over the past 20 years has improved scientific knowledge of vine physiology and agronomic criteria for correct management of a modern vineyard. All the proposed training methods are adaptable to a broad range of environmental conditions; they have also been envisaged to supply high quality products using more or less extensive mechanization.

Short-pruned cordon systems, such as the upgraded SPC, DC, FC, FMC, and MSPC, appear to be best-suited to replace annually renewed long-cane systems, because they are especially adapted to modern winegrowing methods in which integration with machines is the key. Special mention should also be made of the very recent COMBI system, which opens up the path for more use of existing machines for the DC and for a new vineyard model, while still respecting the basic physiological rules governing grape vine cultivation.

Yet, now and in the immediate future, advantages of modern vine training methods can only be exploited to the fullest if there is a strongly specialized vision of viticulture. This requires an uncompromising commitment to specific machinery such as tractors, sprayers, pruners, and har-

vesters, and a high level of technical competence for the timing and methods of handling the vines. ■

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MONDAY, JUNE 20

Phenolics Symposium — from Vineyard to Winery

Basic chemistry of phenolics — Historical perspective, Jim Kennedy, Oregon State University

Biochemistry of phenolic synthesis, Norman Lewis, Washington State University

Methods for analyzing phenolics in research: Why should industry care? John Thorngate, Allied Domecq Technical Services, William Hill Winery

Analyzing phenolics in a winery, Jim Harbertson, Washington State University — Prosser

Fruit maturity & phenolics (hang time), Doug Adams, UC Davis

TUESDAY, JUNE 21

Phenolics *(cont.)*

Cultural practices and environmental factors, Mark Downey, CSIRO Plant Industry, Australia

Phenolics in winemaking, Roger Boulton, UC Davis

Phenolics, oxygen, and barrels, Andy Waterhouse, UC Davis

Wine pigments and tannins, Veronique Cheynier, INRA, Montpellier

Bottle ageing, Helene Fulcrand, INRA Montpellier

Sensory aspects of phenolics, Stéphane Vidal, Inter Rhône

Tasting of various aspects of phenolics in wines, Ann Noble, Emeritus, UC Davis

Papers from Symposium to be published in *American Journal of Enology & Viticulture.*

Filtration workshop, (1/2-day — to be repeated) Organized by Roger Boulton, UC Davis, Christian Butzke, Sakonnet Vineyards, RI. Hands-on demonstrations and presentations on fundamentals of all types of filtration.

WEDNESDAY, JUNE 22

Method Validation seminar (3-hour seminar) Gordon Burns of ETS Labs., Pat Howe, Allied Domecq Technical Services, and Steve Kupina, Canandaigua Wine Co.

WEDNESDAY/THURSDAY

Oral and Poster Sessions, Keynote Speakers, Exhibit Hall

FRIDAY, JUNE 24

Science of Closures seminar

— Co-organized by Patricia Howe, Allied Domecq (CA), and Christian Butzke, Sakonnet Vineyards (RI), (moderators), R. Boulton.

Physics of wine bottle closures, Roger Boulton, UC Davis — Diffusion versus permeation of bottle headspace gases; component diffusion versus bulk flow of permeation; influence of layers and materials on diffusion, permeation; thermal expansion and pressure differentials; shipping, storage, and ageing conditions; variation in permeability and bottled wine quality.

Variability in permeability of corks and closures, Richard Gibson, Scorpex Wine Services, Australia — Bottle-to-bottle variation in wine shelf-life; permeability measurements of closures, how are these measurements made? Variation in permeability of alternative closures; comparison of synthetics to cork, laminates, and screw caps.

Measurement of gas permeability, Jim Peck, G3 Corp, Modesto, CA — Equipment to measure gas permeability; magnitudes and variations of closure permeability; range of closure and seal types.

Oxidative reactions in bottled wine, Andrew Waterhouse, UC Davis, Oxygen uptake, radical formation in wines; difference between red and white wine aldehyde formation; SO_2 loss by binding, by reaction; tannin loss and softening in absence of oxygen.

AWRI Wine bottle closure trial on white wine, Analytical data — decline of free and total SO_2 with time, relative to closure type; color changes with time and closure; sensory data.

Closure considerations and choices, Matching of closure type to wine type, shelf-life or ageing, R. Boulton; Sensory changes in a long-term trial, AWRI; Consumer preference/Image of closure yypes, Anna Marin, OR State Univ.; Sulfur dioxide Levels in U.S. commercial wines, C. Butzke; Free and total SO_2 in bottle; What are closure options?

Where do we go from here? Pat Howe and Christian Butzke

Visit www.asev.org for updated schedules and information

Embracing the Sauvignon revolution

May 10-11, 2005

The second International Symposium on Sauvignon Blanc will be hosted by the Lake County Winegrape Commission. Grapegrowers, winemakers, and other Sauvignon Blanc experts and enthusiasts will gather at Konocti Harbor Resort in Kelseyville, CA to explore, taste and experience Sauvignon Blanc from regions around the world.

"This process of bringing together over 250 stakeholders from industry and academia at an international level is extremely exciting. It also shows the attention the consumer is paying to this fast-rising grape variety." says Rick Gunier of the Lake County Winegrape Commission.

Agenda includes:

MAY 10:

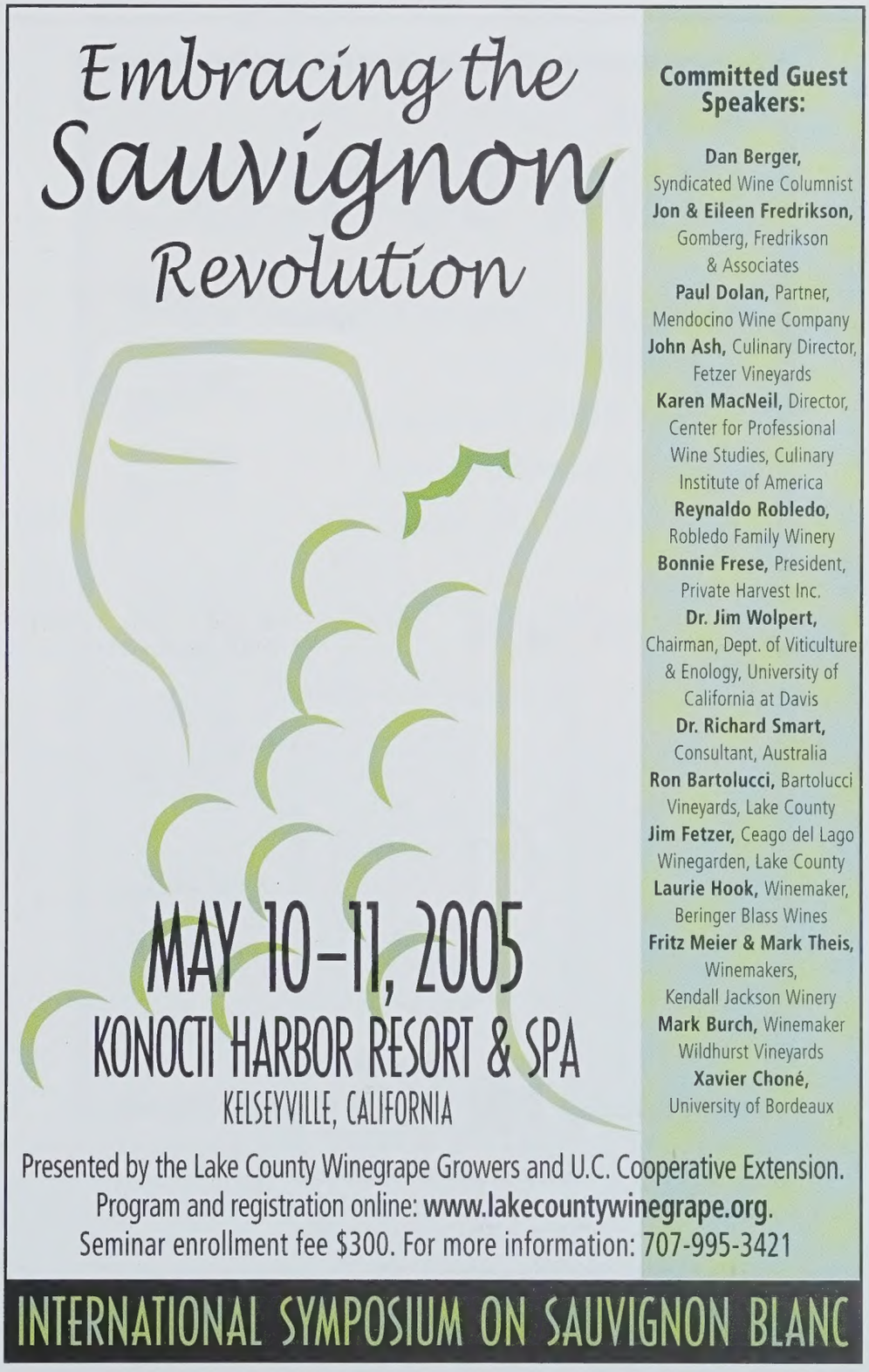
- History of Sauvignon Blanc in California, 1960s to the present;
- World view of Sauvignon Blanc: what the sales trends are showing us;
- Selling Sauvignon Blanc as an international product;
- Sauvignon Blanc as a wine category in the retail and on premise trade;
- Sauvignon Blanc styles of the world;
- Restaurants and Sauvignon Blanc: successes and challenges;
- Award-winning Sauvignon Blanc and the Latino market;
- Fancy food trends and what to pair with Sauvignon Blanc.

MAY 11:

- Sauvignon Blanc trends and future in California;
- Influence of canopy management and climate on Sauvignon Blanc;
- Organic and biodynamic farming systems for Sauvignon Blanc;
- Harvest date and yield effects on Sauvignon Blanc;
- Terroir influence on north coast Sauvignon Blanc;
- Terroir components' influence on the aromatic potential of Sauvignon Blanc grapes;
- New Zealand Sauvignon Blanc;
- California Sauvignon Blanc winemaker panel;
- North Coast winemaker panel.

Many seminars include wine tasting. Additional meals and tasting events are included in the symposium cost.

To register, visit www.lakecountywinegrape.org or e-mail: shannong@lakecountywinegrape.org.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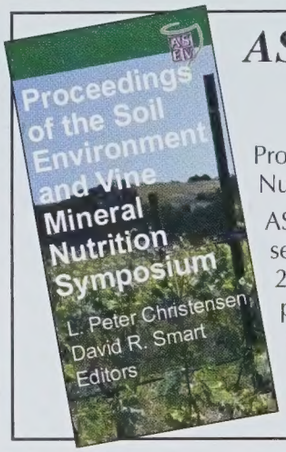

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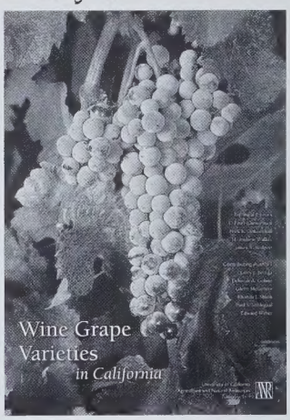

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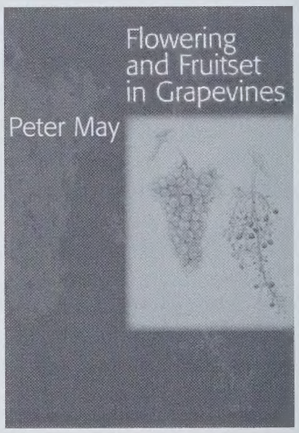

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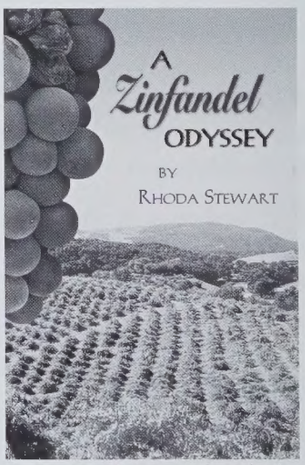

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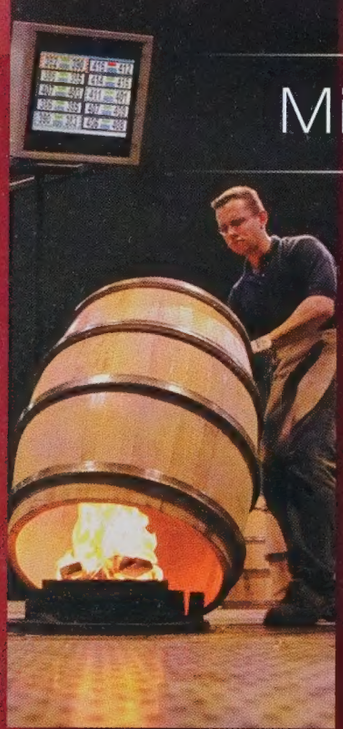

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